A WINDOW OPEN ON THE WORLD

The UNESCO Courier

UNITED NATIONS EDUCATIONAL SCIENTIFIC AND CULTURAL ORGANIZATION

JUNE
1956
(9th year)
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KILLERS OF THE INSECT WORLD

★

The Big Five of ancient and modern 'Plagues'

★

A new threat: Super races of insects defy insecticides

BEAUTIFUL, BUT...

Houses of the Banana tribesmen in French Cameroons are built on stilts above a swamp—teeming with mosquitoes. Village is one of some 200 scattered throughout a forest area where ways of fighting malaria are tested by an Anti-Malaria Experimental Centre. (See page 22)

WHO - Pierre Pittet

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The UNESCO Courier

Vol. VIII—No. 12 JUNE, 1956

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COVER PHOTO

It is no longer necessary to cremate the bodies of plague victims—current practice in the past. Bodies are usually buried by special squads provided with paraphernalia like masks, protective garments and sometimes boots, rubber gloves or stout canvas mittens.

Institut Pasteur, Paris

THERE are many diseases that cannot spread unless carried by insects. They are among the most ancient afflictions of mankind, and have played their part in shaping his history. Malaria has influenced the rise and fall of civilizations, epidemics of plague and of yellow fever have again and again decimated populations in the old and the new worlds, while outbreaks of louse-borne typhus have often determined the outcome of military campaigns. Sleeping sickness and a less well-known disease, onchocerciasis, have held back progress in Africa.

These and a score of other diseases carried by flying and crawling insects have enfeebled whole sections of the human race, depopulated fertile food-producing tracts, and held down man's levels of living particularly in the tropics but also in temperate climates. Despite the strides that have been made in our own day towards the control of many of these scourges, there is scarcely one which does not still represent an actual or potential danger to large numbers of human beings.

★

Most of these diseases have been known and feared for centuries, but it was not until about 60 years ago that scientists began to suspect the part played by insects as carriers. It was only in the early years of the present century that painstaking research established with certainty the action of many different species of insects such as mosquitoes, tsetse flies, sandflies, fleas, lice, as well as of ticks and mites in transmitting many pestilences.

In the first flush of enthusiasm following these discoveries it was thought that, once the carrier was known, any disease would be virtually conquered. Indeed, in a relatively short time yellow fever was banished from most of the cities of the Americas, the incidence of malaria was reduced particularly in the towns and in the more temperate zones, and certain other diseases were successfully attacked.

Rapid progress, however, became possible only after the discovery during the last war of the "residual" insecticides, of which the best known is probably DDT. The special character of these chemicals is that they remain deadly for periods

(Cont'd on next page)

(Continued from previous page)

ranging up to several months after application One of their first triumphs was to strangle the threat of typhus epidemics during and after the war. Next, they proved amazingly effective when correctly used to control malaria, even in the sparsely-settled rural districts. There is scarcely an insect-borne disease against which these new chemicals are not being used today with greater or less effect.

But again disappointment has followed too optimistic hopes. First the common housefly, and now some mosquitoes as well as lice, cockroaches and bed-bugs in certain areas, have shown that, after a few years of exposure to the action of these killers, they can develop resistance which protects them from fatal effects. In the case of the housefly this happens rather quickly, and these chemicals have therefore become of little value. With the mosquito, however, the insecticide can be used effectively for several years, during which period an all-out campaign is able to eradicate diseases like malaria so that, if the mosquitoes should, in time, develop resistance, there is no malaria left for them to carry.

Another and very serious difficulty is that many insect-borne diseases appear to exist more or less permanently among wild animals which thus provide a reservoir of infection that may suddenly spread to start epidemics among domestic animals and humans.

Yellow fever is known to be firmly entrenched in the jungles among monkeys and other animals; plague smoulders in many places among wild rodents whence it can easily spread to the rats that live with men; the trypanosome that causes sleeping sickness exists permanently in wild game in Africa and is carried to men and cattle by the tsetse fly. There are many other examples among diseases caused by viruses and "rickettsiae".

It would be a serious mistake to underestimate these ancient enemies of mankind. It is already clear that the residual insecticides, powerful weapons though they be, do not provide the final answer to the disease-carrying insect. Nor is there at present any prospect of eradicating those diseases that have become permanently established among the domestic and wild animals. There they remain, a constant threat calling for constant watchfulness.

World Health Day on April 7, this year will, I hope, serve to make people everywhere realize that, although the insect-borne diseases are being increasingly held in check, they are not yet conquered. To achieve that final victory man will need all his intelligence and resourcefulness. Above all, he will need to act in concert, for this group of diseases is one of the greatest challenges to international health action.

Dr. M. G. Candau

Director-General, World Health Organization

Doctors in Cairo, Egypt, at special ophthalmology course.

WORLD NOW HAS 1,200,000 DOCTORS

THERE are now 1,200,000 physicians in the world according to a recent survey of the World Health Organization; which also reveals that between 50,000 and 60,000 new doctors graduate each year from some 600 medical schools in 85 countries. The WHO report points out that this is not enough in view of the world's health needs and the inequality of distribution of doctors in different countries.

There are only 14 countries, it states, fortunate enough to have one doctor to serve every thousand inhabitants or less. But there are 22 countries where only one doctor is available for 20,000 people or even more. Between these two extremes, the figures vary greatly for the rest of the 124 countries and territories which make up today's world. In addition, the report adds, many doctors are engaged in teaching, research, administration and other duties which are not directly concerned with the care of patients, and this must be taken into account when looking at the statistics. The report also confirms previous findings that rural areas are under-manned while cities often have too many medical practitioners.

The WHO study underlines the "definite, immediate need for planning the construction of medical schools" in many parts of the world. It shows that while nine countries have one medical school for less than one million of population, there are 13 countries with only one medical school for 9 to 17 million people. Distribution of doctors and medical schools by continent is shown below.

DISTRIBUTION OF DOCTORS AND MEDICAL SCHOOLS BY CONTINENTS

Areas	Population	Number of medical schools	Population per medical school	Number of physicians	Population per physician	Annual number of medical graduates
Africa.....	211,851,000	14	15,132,000	23,253	9,111	855
North & Centr. America.....	233,872,000	122	1,917,000	247,220	946	8,930
South America .	120,731,000	51	2,367,000	48,202	2,505	3,733
Asia	1,370,961,000	152	9,020,000	201,502	6,804	11,582
East. Med.	83,112,000	13	6,393,000	16,970	4,898	859
Europe	614,831,000	237	2,594,000	643,144	956	27,177
Oceania	13,910,000	6	2,318,000	12,083	1,151	753
	2,649,268,000	595	4,453,000	1,192,374	2,222	53,889

KILLERS OF THE INSECT WORLD

They once conquered whole armies

Science now has them on the run

IN the history we learned at school battles were won by the brilliant tactics of generals, marshals and admirals and sometimes by the special interposition of Providence. Today, however, we have come to recognize that generals were often relatively unimportant.

In many cases, the real victor is shown to have been epidemic disease. Among the most important of these diseases is louse typhus which has decided the course of many battles and campaigns. In 1632 for example, Gustavus Adolphus and Wallenstein prepared for battle near Nuremburg, but before the slaughter could begin both armies had to flee before the ravages of typhus.

There does not seem to be very much doubt that Napoleon's worst enemy was General Disease, among whose ablest henchmen was the louse. When Napoleon prepared for his advance into Russia in 1812 he mobilized about half a million men. In June of that year typhus began to appear and by July, after Ostrowa, there were 80,000 ill.

When the retreat from Moscow began there were less than 100,000 troops fit for service. Another 80,000 sick were left at Smolensk in November and when Vilna was reached in December the army had dwindled down to 20,000 men.

It is not necessary to dwell on the horrors the sick had to endure in Vilna. By the end of June 1813 only 3,000 remained alive !

During the course of, and after, the first world war millions of people died from typhus, many more indeed than were killed by bullets.

by Dr. B. de Meillon

South African Institute of Medical Research, Johannesburg

Ten years before his Russian campaign, Napoleon had been severely defeated—by the mosquito. In 1801 when his brilliant Italian campaign was at an end and he had defeated the Austrians and concluded the treaty of Marengo, he decided to occupy the island of Haiti and from there strengthen the forces in Louisiana on the mainland of America.

He therefore despatched Leclerc with 30,000 troops for this purpose. Haiti was at this time ruled by that tragic figure Toussaint Louverture who, ironically enough, had shortly before helped the French drive the English out of the island.

Toussaint, with his ill-trained and badly equipped army, decided to defend his homeland. For the Haitians the situation appeared hopeless, especially when Toussaint was captured. But when all seemed lost, a little black and white mosquito, carrying yellow fever, began to take a hand in affairs and by 1803 Leclerc had lost 23,000 of his troops. He was forced to evacuate the island, and the Republic was saved. (See the UNESCO COURIER, N° 2, 1954.)

In 1885, de Lesseps, the creator of Suez, set out to cut the two Americas in *(Cont'd on page 7)*

WHO - Marc Riboud

CHANCE OF SURVIVAL for these Iranian children is only fifty per-cent— half the babies born in their village die in infancy or childhood. Many deaths—both infant and adult—are caused by insect-borne diseases in this part of Iran. (See next page for a story on how the people of Farimaneh in Iran, fought back against insects that bring sickness and death to their village.)

IRAN'S VILLAGERS HELP THEMSELVES TO HEALTH

1

2 WHO Marc Riboud

3

The people who live in the Sabzevar district of Iran are plagued by insect-borne diseases—malaria, typhus and trachoma, a blinding eye disease—to name only the most common. Villagers had always accepted these sicknesses fatalistically—until last year, when the Iranian Government began disease control operations in their area. A health and sanitation team which included WHO personnel began to work in 22 villages where the incidence of disease was highest, and the idea of health precautions and better hygiene gradually caught on. In Farimaneh, where sanitation work started, a health council was set up, the water supply was improved and cleaned, the six existing latrines were increased to 63 and rubbish was dumped in pits dug outside the village. These and other co-operative activities removed the most obvious threats to health. Photos show: (1) A "shot" of BHC powder deals with typhus-bearing lice (2) Streets were soon cleared of rubbish and swept clean (3) Wall posters put up to encourage youngsters to be health-conscious.

KILLER INSECTS *(Contd)*

THEY MOULDED THE DESTINY OF NATIONS

half. The expedition was a failure largely because of the ravages of yellow fever, and de Lesseps, who had once been hailed as the greatest conqueror of nature and who had received honours from kings, governments and scientific bodies, returned to France a broken man and died in comparative poverty.

A few years later the Americans began to work on the Panama canal and they too nearly had to abandon the project because by 1905 yellow fever was again taking a great toll.

It was at this juncture that a U.S. Army surgeon, General Gorgas, took charge of the health of the expedition. By 1914, when the canal was completed, the death rate was lower than that of any American city or state.

Such is the impression that this disease made on the minds of men that it has inspired at least one well known legend, that of the "Flying Dutchman", which is thought to refer to a ship stricken with yellow fever and refused entry into port, and one equally well-known poem, Coleridge's "The Ancient Mariner". When this sole survivor tells the wedding guest:

I looked upon the rotting [sea
and drew my eyes away;
I looked upon the rotting [deck,
and there the dead men [lay...

he is probably describing an epidemic on board ship in the calms of the Caribbean Sea.

In Africa today the population is estimated to be 135 millions... yet it has been calculated that there is room for nearly 2.000 millions. Why is it that this vast continent is at present only carrying 7% of the possible total?

There are many answers to this question but the chief among them is undoubtedly an insect-borne disease, and of the numerous diseases of Africa none has played a greater part in the past than sleeping sickness of man and nagana of cattle, both carried by tsetse flies.

It seems highly probable that Africa earned its name of "The Dark Continent" because of the tsetse fly. Early Arab and Portuguese travellers were considerably hampered and disaster often overtook them. Indeed the gradual withdrawal of the Arabs from the interior to the Eastern coastal belt was certainly due to the tsetse fly.

Up to the year 1880 human sleeping sickness was almost completely confined to West Africa and known under a variety of names. Many Negro slaves imported into places as far apart as the West Indies and Martinique were known to suffer from a kind of lethargy and melancholy. This was attributed to homesickness and the afflicted person was supposed to be dreaming of his homeland.

Early historians remark with interest that even the whip could not awaken them from their dreams. Longfellow in his "Slave's Dream" written in 1842, most probably describes a case of sleeping sickness:

Bes de the ungathered rice he lay
His sickle in his hand;
His breast was bare, his matted hair
Was buried in the sand.
He did not feel the driver's whip;
Nor the burning heat of day...

Since 1880 sleeping sickness has spread east over most of central Africa as far as the Great Lakes and south into Portuguese East Africa and Bechuanaland.

Increased travel and the gradual opening up of the continent has undoubtedly played a large part in aiding the distribution of the disease. Stanley (of "Dr. Livingstone, I presume" fame) is regarded with great suspicion in this respect. In 1887 he started off on an expedition to rescue Eduard Schnitzer, better known by the romantic name of Emin Pasha, and Stanley's porters from the Lower Congo are said to have brought the disease to the Great Lakes where it was previously unknown.

Among all the diseases to which man is subject malaria is without doubt one of the most important. If you take a map of the world and draw a line along 60 degrees north latitude, and one along 30 degrees south latitude you will have a wide belt in which malaria occurs. Some areas in this belt are free from the disease, but on the whole it is fairly evenly spread between these two lines of latitude.

Within this vast area millions of people die from malaria, many more suffer from the weakening effects of the disease, countless hours of work are lost and the direct and indirect influence on production would stagger the imagination if it could be calculated with any certainty. Through malaria civilizations have been wiped out, successful colonization prevented, and large tracts of fertile land have been depopulated.

Bubonic plague, transmitted from rat to man by fleas, has also done much to decimate populations and it is said that the great pandemic, known as the "Black Death" which started in the 14th century and raged for four hundred years, killed twenty-five million people in Europe alone. (See page 15.)

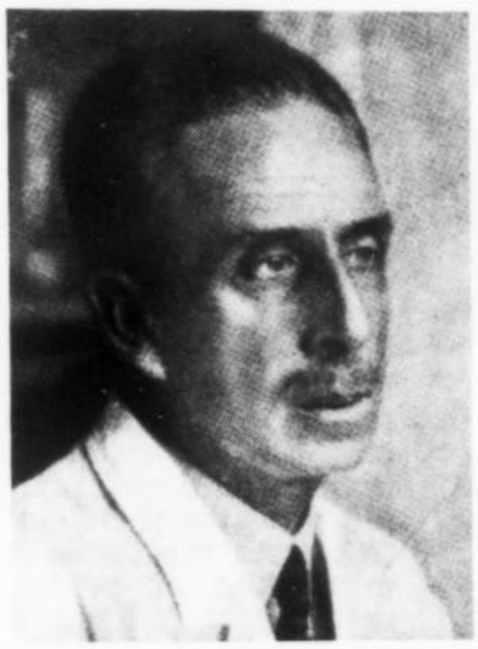
There are, of course, many other insect-borne diseases than those I have mentioned, such as filariasis, relapsing fevers, leishmaniasis, rickettsial fevers, virus diseases and so on which, though perhaps less spectacular, have nevertheless produced their quotas of death and illness. Many of them still present problems of great importance today.

The reader may well ask what has been done about all this? Many of these diseases are now under partial or complete control in many countries. How has this been achieved? What is the overall technique which has led in many cases to success and will it be applicable in the future?

The vector-borne diseases depend for their existence on three things, namely, 1. the host, e. g. man, and often in addition some other animal, 2. the parasite, e. g. Plasmodium, 3. the vector (or carrier of the parasite) e.g. the Anopheles mosquito. Break this chain anywhere and the disease ceases to reach man. In the early days emphasis was laid on the host or the parasite. This was largely due to lack of knowledge of the vector.

Man on the other hand was readily available. He was, and still is drug conscious. At a word he will open his mouth and swallow a pill! Mass application of drugs, however, presents great administrative difficulties and has rarely been entirely successful on its own. Also really effective drugs exist for only a few diseases and they are generally costly. *(Cont'd on next page)*

CARLOS CHAGAS AND THE CONE-NOSED BUGS



Copyright J. Pinto

Some 45 years ago, Carlos Chagas, a Brazilian scientist, made medical history by the method he used to discover a disease which now bears his name: "Chagas disease", a fever which can cause severe and often fatal damage to the heart. Chagas achieved the still unequalled distinction of having found the cause of a disease before the disease itself. In 1909 while doing anti-malaria work in Brazil, Chagas became interested in the large and voracious blood-sucking bugs with cone-shaped noses which infested local mud huts. Laboratory tests showed these bugs were carrying microbes similar to the African trypanosomes which cause sleeping sickness. Chagas next found that these microbes could cause disease in laboratory animals. Returning to the place where the bugs had been found, Chagas discovered a cat with similar microbes in its blood and then, in the same house, a young girl suffering from fever. He clinched his important discovery by finding the microbes in her blood also.

KILLER INSECTS (Cont'd)

CLUES FROM SCIENCE'S 'ROGUES' GALLERY'

With the coming of the 20th century and the great discoveries of pioneers like Manson, Ross, Grassi, Nicolle and Reed, emphasis became focused on the disease carriers themselves and their study was intensified through the years, resulting in marked and often phenomenal success in disease control. How has this been achieved?

The first problem in the study of any creature is its identity. Things must be identifiable before we can study them, write about them and exchange views about them. The naming and identification of the insect vectors has in this way played a very significant role and lies at the very foundation of the study of their habits and ecology.

Case of mistaken identity

DISCOVERIES relating to the identity of a certain carrier of malaria, namely, *Anopheles gambiae* in Africa, enabled malariologists to recognize the species and its potential dangers when it was accidentally introduced into South America.

The species having been identified it was a simple matter to read all that was known about it, to carry out further work and finally to single it out and strike at its weakest point.

In the early days of malaria control in South Africa a puzzling situation was discovered. The vectors of malaria had been identified as *Anopheles gambiae* and *Anopheles funestus*. Furthermore it was found that they were largely house-frequenting and preferred biting man to any other animal.

The method and site of attack on them appeared obvious, namely, with insecticides in human habitations. However, further work showed that large numbers of *funestus* could be captured in holes in the ground, under stones, in crevices in river banks, under vegetation etc.

Further, they were also found in areas where malaria occured only sporadically or not at all. What was to be done with this huge insect population, how were they to be controlled, was it a practical proposition, could it be financed and above all was it necessary?

The problem, however, was quite easily and neatly solved when it was discovered that these out-of-door customers were not *funestus* at all but another species which was not a disease carrier but which resembled *funestus* so closely in the adult stage that they were to all appearances identical. Discovery of their larval and egg stages provided the key because they were different and easily recognizable. The correct naming of carriers is the basis of an understanding of the whole problem of insect-borne diseases.

Once a carrier is properly labelled and can be recognized under all circumstances the next procedure is to find out all about it. What are its requirements, how does it live, why is it a carrier, and so on?

Exterminated by air attack

ANSWERS to these questions are of vital importance as they often yield the answers to control. It is rare for one single line of attack to emerge from such studies. Usually many vulnerable points are revealed and it is then a matter of expediency, costs, local conditions and so on as to which methods are applied.

A method which is successful or promising in one area may be a relative failure in another because local conditions are not applicable. In Zululand, for instance, the tsetse fly *Glossina pallidipes* was exterminated largely by aerial spraying of insecticide. The area was comparatively small, there was little likelihood of reinfestation, the cost was high but economically worth it. The method is obviously only applicable under these conditions and cannot be applied indiscriminately all over Africa.

It is in this search for knowledge about the economy, habits and requirements of the carriers of disease that much work still remains to be done. Nowhere is this better illustrated than in the control of mosquitoes At least twice in the history of malaria control a feeling has been apparent that the problem was solved.

Firstly, when the carriers were found to be *Anophelines* the answer appeared to be simple: destroy them and the disease will disappear. It did not take long to discover that this was not so easy. The second occasion arose when the modern insecticides like DDT became available. But instead of putting an end to work on the carriers this insect killer has served as a great stimulus to research and in many instances revealed how ignorant we are in many ways of disease carrier biology.

It is fairly safe to say that more research is being done today than ever before because of the gaps that have been revealed in our knowledge through studying the effects of DDT. The emphasis today, of course, is still on the residual insecticides and their names are on everyone's lips.

Biologists, however, have not forgotten that many ecological factors, including the habits of man, have to combine in a particular manner before the complicated series of events which lead to successful transmission and maintenance of a vector-borne disease, takes place.

Sometimes it is cheaper and easier in many cases to bring about a change in these nicely balanced events. In many cases it is definitely desirable. Teaching people to use soap and water and to keep themselves clean is obviously a better method of controlling louse-borne typhus than continual use of DDT. Again, teaching people to water their cattle at places that have been made safe from the tsetse fly is obviously a neater and cheaper method of preventing sleeping sickness than large-scale aerial spraying or bush and forest clearing.

Might set the clock back

IN certain parts of tropical America the insects which carry malaria have been found to breed exclusively in certain plants which live on forest trees. Successful control has been achieved by deforestation and subsequent use of the land for agricultural purposes.

Where slopes are too steep for vegetable growing, useful timber is grown which can be cut easily before the mosquito-haunted plants establish themselves. Further research, this time on the ecology of the plants themselves, may show that they will grow only on certain trees. It may be possible to reafforest with trees that the plants don't like.

Such methods which may be called ecological or biological, are often so simple and obvious it is hard to believe that they are the result of many years of painstaking research. The future of the control of insect-carriers of disease has never appeared to be brighter than at present—but there is no reason for complacency. Further research is urgently required and must be maintained at a high level.

Modern insecticides have tremendous advantages and have proved a great blessing to mankind but if they tend to halt further biological and ecological research, of which there is already evidence in some countries, they might easily set the clock back.

The living organism is not a machine but a resilient, pliable and variable entity. It has survived aeons of time because of this and is not easy to put aside or destroy.

Resistance to the residual insecticides (see page 29) is being reported more frequently as time passes, their long-term effects on man himself are not properly known and their manufacture is costly and a drain on our resources.

The aim in the future, in my view, should be to find ways of controlling insect-carriers by ecological methods. They will prove to be the cheapest, the most lasting and in the long run the most effective.

WHO

Match

A LITTLE BLACK GNAT

Threatens 19 million people with blindness

Match

A tiny black fly (above, left) threatens something like 19 million people in large areas of Africa and Latin America with a disease called onchocerciasis (pronounced on'-ko-ser-ky'asis). When this gnat bites a human being, tiny parasitic worms enter the human body. They first cause painful lumps, then invade the tissue of the eyes, bringing total blindness. In the Chad, (French Equatorial Africa) insecticides are sprayed by helicopter (above, right) over gnat-infested areas. Disease is already so widespread that tragic replicas of Breughel's painting "The blind leading the blind" are often seen (below).

BLACK GNAT

(Continued)

In the 'Valley of the Blind'

by Anthony Lavers

THROUGH an Irishman's pluck and perseverance a province of Kenya, Britain's East African colony, has been rid of its most dreaded scourge—the tiny flies which brought blindness to thousands of middle-aged African men and women.

The scientist who solved one of the most intriguing medical problems which had defied scientists for over 30 years is genial, burly James Patrick McMahon, a 50-year-old Kenya Medical Department entomologist who left Dublin for army service in 1922, and came to Kenya in 1929 to join the Medical Service.

Insects fascinate Mr. McMahon and in Myanza Province, the vast collection of African tribal lands fringing Lake Victoria, he found them in numbers and variety to exceed his most cherished expectations. And, in particular, one tiny species of fly, known as *Simulium Neavei,* caught his attention. The fly carried the microscopic worm which causes the disease called river blindness.

When the fly bites human beings it transmits the worms which multiply under the skin, working their way towards the eyes. If the disease is not halted, by middle age they destroy the eye tissues and bring total blindness.

Finding the adult fly was easy enough. In some areas there were concentrations of thousands in every forest glade. But to kill it, science had to know where and how it spent the larva and pupa stages.

River blindness—onchocerciasis to medical workers—is confined in Kenya to the hilly regions of Nyanza Province. The highlands are intersected by hundreds of mountain streams. Where there was running water the concentration of fly was strongest and the incidence of blindness among African villagers most prevalent.

Medical men baffled

FOR this first attempt to solve a problem which had baffled dozens of medical workers, McMahon chose an area dubbed "The Valley of the Blind", where one out of every six tribesmen had lost his sight, and 90 per cent of the population in some places was infected. World War II put an end to the work, but McMahon resumed it in 1946, by then convinced that the fly somehow bred in rivers.

He therefore tried "dosing" rivers with a DDT solution. It worked, and subsequent tests in the "Valley of the Blind" showed that the fly had been eradicated from that district. The riddle of the fly's life cycle remained unsolved, but McMahon now had an effective weapon against his enemy, and he was quick to use it.

The main river blindness area was in the northern districts of Nyanza. Mr. McMahon began an 18-month survey to determine the exact area of infection before the work of fly elimination began. It covered an area of 6,000 square miles and narrowed the infection focus down to 1,000 square miles.

Steep mountain valleys, dense forests and thick bush were the survey's main obstacles. The teams had to hack 400 miles of trails through the forests and strip the bush from the banks of hundreds of streams and brooks, most of them unmapped. Snakes were as common as pigeons in London's Trafalgar Square, and encounters with buffalo—Africa's most dangerous big game—were part of the daily routine. But the greatest danger lay in getting lost in dense jungle.

This happened several times, culminating with the disappearance of an African worker who tried to make a short cut back to camp. He died of shock and exhaustion and his body was discovered two days later. When the survey was complete, each team had walked some 3,000 miles through some of Africa's toughest country.

Copyright Camera Press.

HUNTER AND HUNTED : Mr. J. P. McMahon, the man who solved the river blindness problem in Kenya, examines a crab bearing the larvae of the black gnat which carries the blinding disease.

Dosing the streams in the affected area was followed with partial success in 1947. In the meantime McMahon continued his search for the larvae's habitat. Nearly all species of fish, crabs and insects found in the North Nyanza rivers were examined. Streams were dammed and diverted. At one stage McMahon considered hiring a diver's suit to explore the river beds personally.

Then came encouragement. Another Kenya scientist, Dr. V. D. Van Someren, found the larva of a fly similar to *Simulium Neavei* attached to a mayfly nymph. He told McMahon of his discovery, and the indomitable Irishman again plunged—quite literally—into the search.

He returned to the southern highlands and searched every square foot of a river running through a badly infected area. The fact that he ran a grave risk of contracting a disease for which there is no cure did not deter him. He and his African assistants spent weeks waist-deep in water —and once more the results were nil.

Other entomologists might well have pigeonholed the river blindness problem as just another African medical mystery. But McMahon and his team simply moved downstream to another and bigger river. And there they met success.

Into the crab's hideout

WADING through the shallows, the team pulled out hundreds of crabs of a hitherto unexamined species. Nearly all of them carried both larvae and pupae of *Simulium Neavei,* McMahon knew he had slammed the door on the river blindness ghoul which haunted thousands of African homes.

Soon the Nyanza medical authorities launched the final drive to exterminate *Simulium Neavei.* When the last of North Nyanza's 170-odd rivers had been given their last dosage of DDT mixture last year, the experts felt reasonably certain that river blindness will never again afflict this peaceful and fertile corner of Kenya.

More than one and a quarter tons of pure DDT were used in treating each of the rivers and tributaries at fortnightly intervals over a three-month period. The whole project, including the preliminary survey work and mapping, had kept Mr. McMahon and his team of four European and 40 African helpers working fulltime for four years.

The dosing programme has been overwhelmingly successful. Eight years ago an area was treated where 36 per cent of the children below the age of six were found to be infected with river blindness. In 1953 a medical survey showed that not a single child in a similar age group had contracted the disease.

James McMahon is now turning his talents to other medical problems. The elimination of malaria and other tropical ills have still to be achieved. But the Government of Kenya did not forget his victory, and the 1955 New Year's Honours List announced the award of the Order of the British Empire to Mr. J. P. McMahon, senior entomologist, Nyanza Province, for a "discovery of very great importance to science and medicine." His pioneer work in solving the fly's life cycle problem, the citation added, was "carried out at considerable risk of infecting himself."

Match.

DESERTED VILLAGE in French Equatorial Africa (left) is one of many abandoned by people who lived in an area heavily infested by the black gnats whose bites cause a blinding disease. Many of the middle-aged inhabitants were already blind. Here and in other large areas of Africa, a blind man being led by a youngster whose eyes have not yet been affected by the disease is a common sight (right).

WHO and UNICEF

DISEASE OF DIRTY HANDS. — One of the oldest known diseases and still one of the most widespread is trachoma. If left untreated trachoma causes blindness. It flourishes where elementary hygiene does not exist and has thus been called "the disease of dirty hands". It is spread by flies in countries where flies are so numerous that people become indifferent (left). Anti-trachoma campaigns are carried out with aid from WHO and UNICEF. Right, "nurses" of school health committee apply anti-biotic ointment at Sanafir, Egypt.

The sleep that kills

1

by J. Ford

Director, East Africa Tsetse and Trypanosomiasis Research and Reclamation Organization

FROM the southern edge of the Sahara Desert to Zululand in the Union of South Africa the peoples of tropical Africa are afflicted by a number of diseases carried by tsetse flies (*Glossina*).

These insects infest about four and a half million square miles of land. In much of this vast area (half as great again as that of Australia) their bite may infect man with a minute protozoan organism, a trypanosome, which produces the fatal sleeping sickness. Over all of it tsetse flies transmit other trypanosomes which are fatal to cattle and other domestic animals.

This means that the African, even if he is fortunate enough to live in an area free of sleeping sickness, may be deprived of much needed animal protein in his diet, while his agricultural activities suffer both from lack of fertilizing manure and of draught animals.

Further, there is, naturally, a tendency for the human population, with its cattle, to crowd into the relatively small areas which are free of tsetse fly. The result is that the land is overworked and over-stocked and suffers accordingly.

In short, the tsetse fly, through the diseases it transmits, affects directly or indirectly, the whole economy of tropical Africa and there can be no doubt that the poor situation of the African can be attributed very largely to this terrible scourge.

There are twenty-three known species of tsetse fly, some living in the rain forest, some in the vegetation fringing lakes and rivers, others in the woodlands and bush of drier

★

Photos from French Cameroons on these pages show some aspects of research into sleeping sickness caused by the tsetse fly and treatment that is given to the victims of this dreaded disease. (1) In the second stage of the disease the sick man becomes weak, anaemic and more and more emaciated. He begins to sink into a coma which becomes so deep that he dies of exhaustion and starvation. (2) Villagers wait to be weighed and vaccinated. (3) A young mother and her baby are given injections of lomidine. (4) An entomologist classifies and counts pupae of tsetse flies brought by insect catchers. (5) At the research station of the pilot project in Yaoundé, guinea pigs are strapped to cages filled with tsetse flies. The flies feed off the guinea pigs until they are needed for dissection and analysis.

WHO - Pierre Pittet

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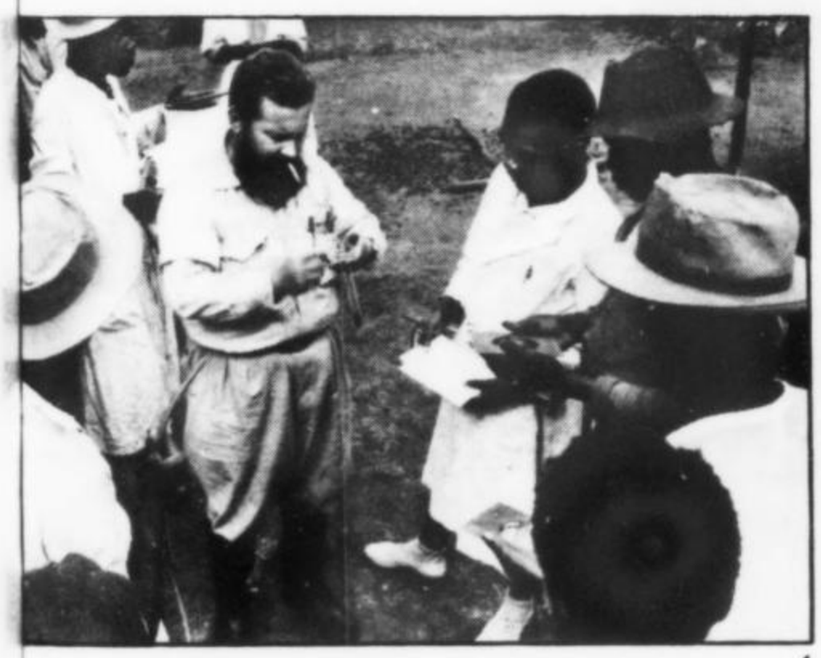

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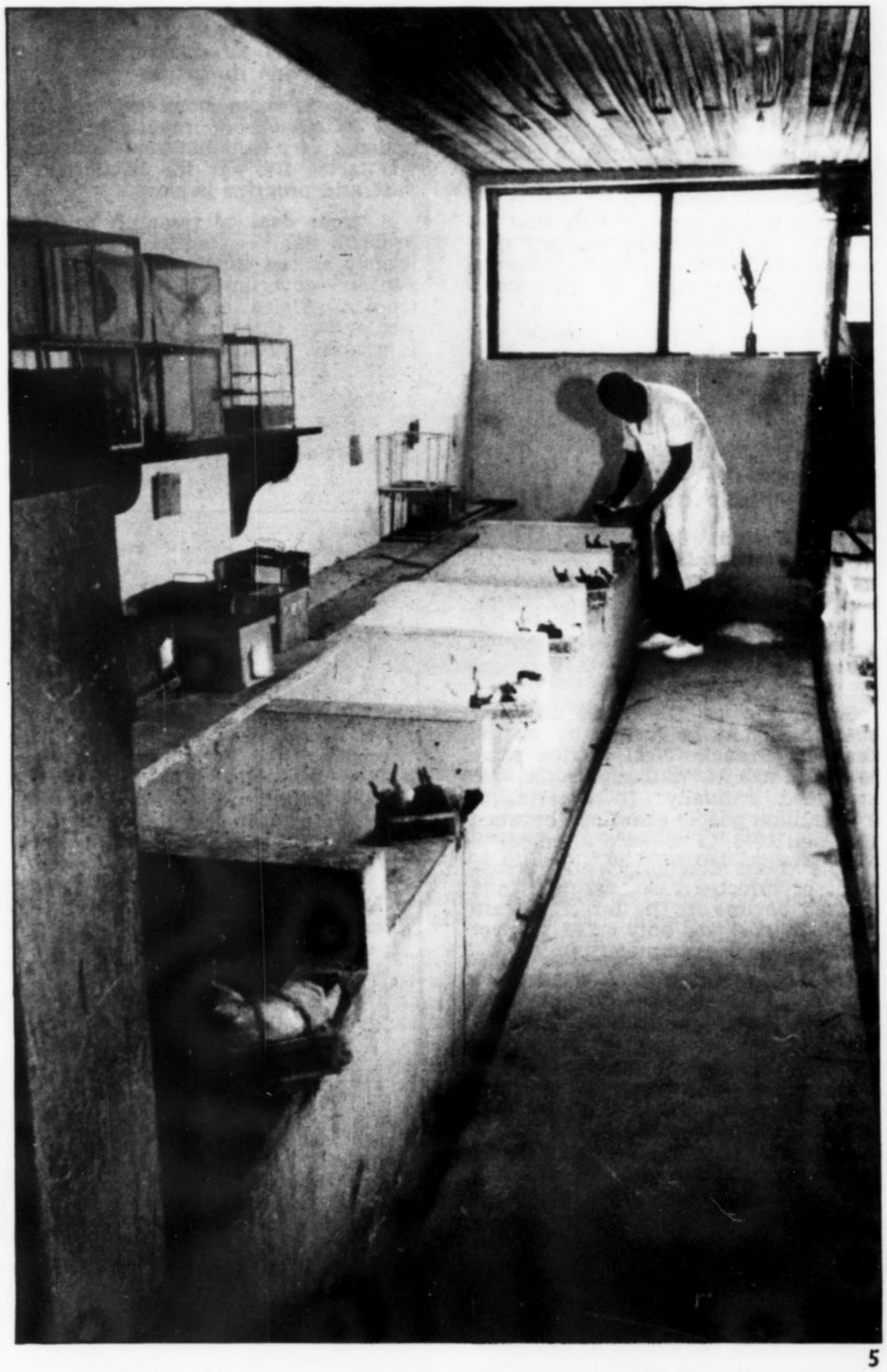

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areas, but all requiring the shade of trees or bush to survive.

They vary in size from that of a large blue-bottle to about that of a common house fly and all feed only upon the blood of animals.

Many of these animals, the wild game of Africa, carry in their blood the parasitic trypanosomes which to them are harmless. When the tsetse fly feeds it may suck up these trypanosomes, which develop in it so that it becomes itself infected and infective.

In the normal course of events it is likely to feed again only on wild animals and no harm is done, but to man or to cattle its bite may bring death.

Just as there are several kinds of tsetse fly, so there are several kinds of trypanosome.

Two species cause sleeping sickness in man. In West Africa, the Congo and as far East as Lake Victoria the disease is generally in the form known as Gambian Sleeping Sickness. It is transmitted by tsetse flies living along rivers so that dangerous foci tend to develop where the people go to draw water or to bathe.

Although these riverine tsetse may feed very largely on reptiles, there is much evidence that man himself is often the only host of the trypanosome of Gambian Sleeping Sickness.

In the afflicted territories millions of people are subject to the risk of this disease and in the past there have been appalling epidemics, for example, in Uganda between 1896 and 1906 when it was estimated that 200,000 people died.

The other form of the human, disease, Rhodesian Sleeping Sickness, is largely confined to East and Central Africa.

Here there is much evidence suggesting that the wild game form an important reservoir of the disease which is largely carried by a tsetse infesting vast areas of dry woodland and not confined to rivers. The Rhodesian Disease is more acute than the Gambian and, untreated, kills much more quickly.

Some twenty-five years ago a drug (Bayer 205 or Antrypol) was produced in Germany which could cure the early stages of both diseases and somewhat later the Americans discovered another drug (Tryparsamide) effective in more advanced cases of the Gambian disease.

During the war other drugs (diamidines, especially pentamidine) were developed in the United Kingdom which not only provided a useful cure

THE SLEEP THAT KILLS

(Continued)

in the early stages, but also showed marked prophylactic effects against the Gambian disease.

But it is only very recently that yet another group of drugs has been produced which offers hope to sufferers in the later stages of Rhodesian Sleeping Sickness.

Because in Western Africa the tsetse carrying sleeping sickness come much into contact with the human population, the human problem receives more emphasis than the problem of cattle trypanosomiasis.

Mass diagnosis

THE French, Belgian and British Governments of the West African territories maintain large sleeping sickness services, which, increasingly during the last few years, have succeeded in reducing the incidence of the disease to very low levels.

Something of the scale of their operations may be judged by noting that in French West Africa some four-and-a-half million people are examined annually. In Nigeria, of four million people examined between 1931 and 1943, 11 % were infected.

This "mass diagnosis" and treatment of infected cases resulted in a marked decline in the infection rate which in 1950 was only 0.37% in over 800,000 people examined.

The East and Central African areas infested with Rhodesian Sleeping Sickness present a different kind of problem.

Partly because the disease is more acute and so more dangerous, partly because most of the area involved is not, in any case, suited to dense settlement, far fewer people are in danger of infection.

The practice, therefore, is either to remove people entirely out of the tsetse-fly belts, or, where this is impracticable, to gather them into "sleeping sickness settlements" in which, by combined efforts in agriculture they can create islands of land in which, because the trees have been cut down, the tsetse cannot live.

Vast empty spaces

BAD though the effects of sleeping sickness may be, it is possible that if we could fully understand the whole situation created by the presence of tsetse flies, we might well conclude that cattle trypanosomiasis is an even greater hindrance to African welfare and development.

Undernourishment and deficiency diseases are now recognized to provide perhaps the greatest barriers to African progress and these might well be overcome if the vast areas now denied to cattle by the tsetse could be reclaimed.

Up to about 1945 there were only two basic methods of eliminating tsetse flies, although there were a variety of ways in which they could be applied. These were either to kill off the wild game animals which provide the tsetse fly with its food or to cut down the forests and woodlands which provide its home.

In recent years, however, first DDT and later other insecticides have added a very valuable weapon against the tsetse fly, but the battlefield is vast and progress is slow.

A great deal of research into the problem has been and is being done, largely at the expense of the metropolitan governments administering tropical Africa and there are only one or two insects such as the malaria carrying mosquitoes, about which more is known than about the tsetse.

Why, with so much knowledge, can we not go faster?

The reasons these methods are not, and cannot be, applied rapidly are two. First, the vast size of the areas involved, areas sometimes of 100,000 square miles or more, prevents them being tackled as single units.

The second reason is that unless an area so reclaimed can be occupied by forms of land utilization which permanently make them unfit for the tsetse flies to live in, these insects will invade once more from other areas.

Research is directed towards the prevention of disease in man and stock and the reduction of cost of reclamation of land from the tsetse fly.

But the end lies with the African himself—by using intelligently and vigorously the new knowledge that is being given to him, to occupy productively Africa's vast empty spaces.

LIVINGSTONE GAVE HIM THE MISSING CLUE

ON one of his journeys into Central Africa, David Livingstone arrived one day in 1857 at the confluence of the river Tamunak'le. There he came up against a barrier he could not cross. "We were informed," he wrote, "that the fly called tsetse abounded on its banks. This would have brought our wagons to a standstill in the wilderness, and we were reluctantly compelled to retrace our steps." Like others before him, Livingstone was stopped by the tiny yellow-barred blood-sucking insect which is today considered one of the greatest scourges of man and animals in tropical Africa. "Its peculiar buzz once heard," he said, "can never be forgotten by the traveller... When cattle are bitten, they become ill in a few days, then gradually weaken, and it is perhaps months later before they die."

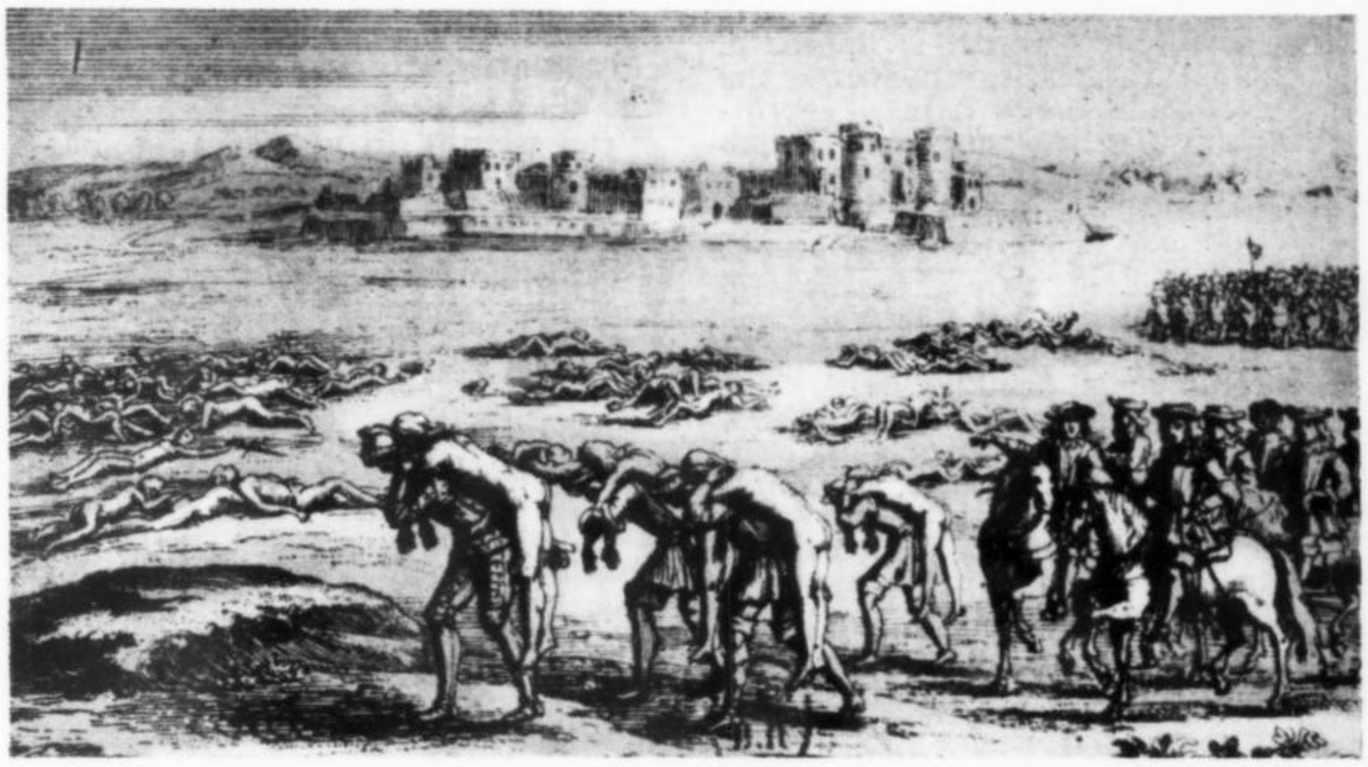
SIR DAVID BRUCE

The story of the discovery of the cause of sleeping sickness begins with this description by Livingstone of the tsetse fly. In 1895 a fatal cattle disease called nagana was raging in North Zululand. An Australian-born British Army doctor, Major David Bruce, who had shown which organism caused Malta fever, was called in. Setting up a laboratory in a wattle and daub hut, he examined blood samples from sick animals and spied a "rapidly moving object... lashing about among the red corpuscles." This he soon identified as a trypanosome, a parasite known to cause disease in animals. He assumed it was the cause of nagana. But how did the trypanosome get into the cattle's blood? He then recalled the books by Livingstone and other travellers. Might there be a link? He sent down two oxen into the tsetse fly-infested plains nearby. They caught nagana —and their blood swarmed with trypanosomes. After endless experiments Bruce conclusively proved that the tsetse fly disease and nagana were the same. So far though no one suspected that human sleeping sickness and nagana might be linked through the tsetse. When a sleeping sickness epidemic flared up in Uganda in 1902 Bruce joined two other scientists near Lake Victoria where 20,000 Africans were dead or dying. Soon he found that not only did the trypanosome cause sleeping sickness but that it was carried from man to man by the same insect that carried nagana from beast to beast. By collecting specimens of tsetse flies from all over the territory (where they were called kiou) Bruce marked out a tsetse location map. It agreed exactly with the distribution of sleeping sickness in the same region.

Still unsatisfied, he put tsetses in muslin cages, fed them on sleeping sickness patients and then let them feed on healthy monkeys. The monkeys caught the disease. He took tsetses from sleeping sickness areas and fed them on healthy animals. Again the animals developed the disease symptoms. Although there are many varieties of tsetse fly and trypanosomes, Bruce had discovered the cause of sleeping sickness and the way it spread. For his work he was later knighted. He did not find a cure but he suggested ways of preventing infection, recommending the killing of wild game which act as "reservoir hosts". And it was he who persuaded a Uganda chief to move his people 20 miles back from a lake shore in the tsetse infested country in 1902 thus saving their lives. Much was still to be done and is still to be done, but Bruce had opened the way for effective attacks on the scourge of the tsetse.

THE TERROR OF PLAGUE IN THE MIDDLE AGES

by Dr. Georges Barraud



ARMIES OF THE PAST were often decisively defeated by plague. Here, King Louis IX of France (St. Louis) is shown during his ill-fated campaign in Egypt (1249-50) helping to bury more than 1,000 French soldiers struck down by a plague epidemic. (In this engraving, French soldiers are anachronistically depicted in 17th century garb). St. Louis himself died from the plague after arriving in Carthage in 1270.

Bibliothèque Nationale, Paris.

For four centuries the West lived in terror of great plague epidemics. The first and certainly the most devastating struck Europe in the 14th century. It took the form of a pneumonic plague, attacking the lungs and causing hemorrhages under the skin which made its victims turn black. From this hallucinating sight came the name "Black Death".

In less than three years—from 1348 to 1350, the "Black Death" killed 25 million people in Europe and some 75 million throughout the world—estimated at half the population of the globe at that time. From then on the plague was an ever-present menace in Europe although its ravages progressively decreased, except for serious outbreaks in Milan in 1628, in Lyons in 1638, the "Great Plague" of London in 1665 and that of Marseilles in 1720.

In Italy, epidemics had occurred as early as 980 A.D. in the Este States and in particular at Modena in 1006 and 1065; they reappeared only in 1311, when not merely the whole Italian peninsula but France, Spain and Germany were seriously affected.

At that time, all diseases were ascribed mainly to astrological causes—to the influence of constellations regarded as benign or hostile and unfavourable. Some people, however, also blamed malignant vapours which rose from stagnant water after heavy rain followed by a heat wave.

The pestilential miasmas came, it was said, from the bowels of the earth ; and the proliferation of insects as well as rats was regarded not without reason as an evil omen foreshadowing plague. Thus in 1120 we find the Bishop of Lyons actually going so far as to excommunicate all the insects in his Diocese ! In like fashion, we also find the authorities of Autun, Mâcon, Lyons and Troyes subsequently issuing edicts condemning rats, caterpillars, slugs, and even weevils. Finally, if we are to believe the account of

(Cont'd on next page)

Institut Pasteur, Paris.

"GARB FOR DOCTORS and other persons who visit plague victims. The mask and eye-pieces are of glass and the long nose is filled with perfumes" reads the 17th century description of costume (left) designed by the personal physician to Louis XIII of France. Masks and robes worn by modern doctors to protect themselves from infection still retain something of the nightmarish aspect of their ancient counterparts.

PLAGUE
(Cont'd)

'Heralded by comets, shooting stars and floods'

the historian, de Thou, an actual "trial" of rats opened at Beaune, in 1530. The rodents were formally charged and were even defended by a lawyer. Needless to say, the accused never appeared in court.

During the second half of the 13th century, the first treatises on plague and how to deal with it appeared. Pierre de Dumouzy, a doctor at Rheims, who wrote the first of these, spoke, even at this early date, of germ-carriers "who can transmit infectious germs, even though they themselves may not be ill... Such are those who have eaten garlic and no longer smell the odour with which they infect others."

Dumouzy advised against physical exercise, baths and massage in times of plague, and advocated light nourishment, prepared dry with vinegar. He completely banned the eating of fruit. He recommended drinking light, clear wine, thinned with water that had flowed over pebbles, been boiled or even been distilled in a silver or glass still. Aromatic disinfectants were essential ; incense, aloes and myrrh were to be burnt in the rooms ; and doctors and priests approaching the plague-stricken had to be careful to carry camphor and a ball of amber in their hands.

Moderation in all things was to be the rule, and chastity a safeguard against contagion. Above all, the patient must keep up his spirits and follow a reconstituting regime, living a joyful and care-free existence. This medical advice, which on the whole is not so out of date as mignt seem, was far superior to the prescriptions ordering bleedings and purges or the taking of theriac or treacle—those classic but highly complex remedies of yore.

It was only two centuries afterwards that anti-plague pharmaceutical preparations, as picturesque as they were absurd, made their first appearance. But the fact is that plague was regarded essentially as a manifestation of God's wrath, a supernatural scourge designed to punish man for his sins and crimes. As La Fontaine wrote in the 17th century it was:

"Un mal qui répand la terreur,
"Mal que le Ciel en sa fureur
"Inventa pour punir les crimes de la Terre" (1).

Arrows shot in the air

THUS, in a treatise published in 1629 Jean Fabre of Toulouse, wrote: "It is sent of God; the angels often receive God's commandment to distil the same poison. The demons too; witches and magicians, also may, by Divine permission and with the aid of the demons whom they serve, become in truth instruments of the plague."

Since the plague was considered of Divine origin, it was natural that it should be heralded by "comets, shooting stars, earthquakes and floods", and other strange phenomena which, according to Fabre again, were "the real precursors and foreshadowers of the plague."

It was equally logical to invoke against it the intercession of the Saints. Between the 7th and the 12th centuries, protection was usually sought from St. Sebastian, the martyr of the arrows, since arrows were regarded as capable of spreading the plague. From the 13th century onwards, however, St. Sebastian was gradually replaced by St. Roch, who had himself contracted the plague in Italy. Always represented pointing at his bubo, (or plague boil) he was the great "healer" of plague in the 15th and 16th centuries.

The great epidemic of "Black Death", thought to have originated in Mongolia in 1346, had been prepared and facilitated by a series of atmospheric disturbances, famines and particularly floods, which are believed to have taken 400,000 lives. In less than a year the great plague is said to have claimed as many as thirteen million victims in Northern China alone. It spread to the West by way of Baghdad, Syria and Constantinople, where it raged for several months.

"The disease was incurable," wrote the Emperor Cantacuzene. "Neither mode of living nor bodily strength was proof against it. Strong and weak were struck down alike; and death spared those tended at great cost no more than those who were bereft of help... Saddest of all was the way the plague sapped its victims of courage. At the first symptoms, they lost all hope, took to their beds and shut themselves off, as it were, from the world. This moral prostration made them rapidly worse and speeded the hour of their death. No words can be found to describe this disease. All that can be said is that it had nothing in common with the ills by which man is ordinarily afflicted, and it was a punishment sent by God."

By way of Greece the scourge passed to the Mediterranean islands, in which two-thirds of the population were struck down. In Italy, even more victims were claimed; 100,000 died in Florence, and as many in Venice ; at Bologna and Ferrara there were 2,000 deaths each day. The epidemic swept across the Balearic Islands into Spain, and across Switzerland into Austria and Germany, where it brought death to 1,250,000 people, including some 125,000 Franciscan monks.

Processions of flagellants

IN France it made its first appearance in a Carmelite monastery at Avignon, and within a few months it carried off 150,000 persons. Having decimated Provence, it ravaged Paris, the Eastern provinces, and particularly Burgundy, where the following grim couplet was composed:

"En mil trois cent quarte huit
"De cent ne demeurait que huit." (2)

England's turn came next: In London 100,000 persons died. Then, Norway, Denmark, Iceland and even Greenland were decimated. All in all, it is said that the "Black Death" of the 14th century carried off between 30 and 40 million people in Europe alone.

As an attempt to overcome this epidemic and appease the Divine wrath, a wave of frightened mysticism swept over Christendom. In many countries, processions of flagellants were to be seen throughout the land, half-naked, intoning religious hymns, and chastising themselves with whips to which crosses of iron were attached. Finally the various kings, and even the Pope, forbade these people to enter their realms, for they engaged in every sort of pillage.

It was commonly believed that wells and fountains had been poisoned and popular anger was aroused against the Jews who were held responsible for these disasters. The Jews were hounded everywhere and large numbers were burned alive, especially in the German-speaking countries. To put an end to these horrible massacres, Pope Clement VI issued two Bulls declaring the Jews innocent. But despite this it was only in Poland that the Jews finally could find refuge, with King Casimir the Great, who gave asylum to whole Jewish colonies.

Fig & pistachio poultices

WHEN the great plague epidemic broke out in Avignon in 1348, the physician-surgeon Guy de Chauliac began to treat tumors by "ripening" them with fig and pistachio poultices and then lancing them with a hot knife.

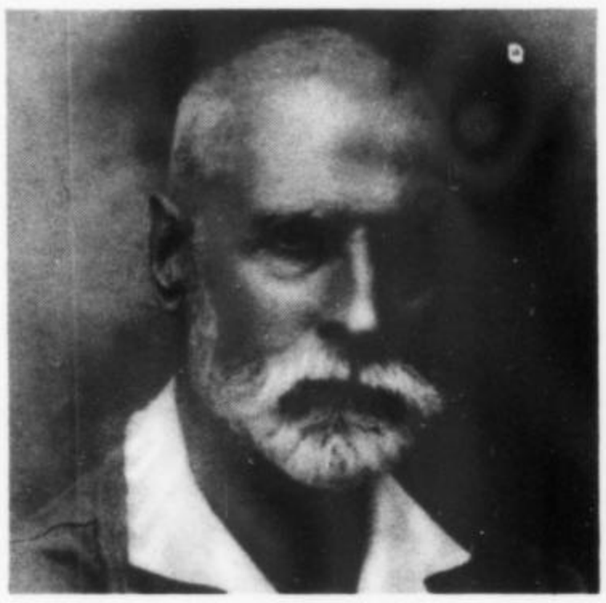
Large quantities of incense and camomile leaves were burnt in public squares and in houses, and rooms were liberally washed with rosewater and vinegar. Doctors began to wear long loose clothing and long gloves, protecting their nose with a sponge soaked in vinegar containing clove and cinnamon powder.

But it was especially in Italy that the most effective public health measures were developed. In 1374, people and merchandise either infected, or even suspected of infection, were forbidden to enter Venice. Patients were isolated in special places outside the towns and the declaration of plague cases became compulsory. In 1377 the Republic of Ragusa initiated the first system of quarantine. All suspected

(Cont'd on page 20)

(1) *A malady that spreads terror, a malady which Heaven in its fury invented to punish the crimes of the Earth.*

(2) *In thirteen hundred forty eight, of one hundred remained but eight.*



ALEXANDRE YERSIN

FLEAS, RATS AND MEN— LINKS IN A DEADLY CHAIN

LT. COLONEL P. L. SIMOND

"THE day you see rats fall dying from the roofs, leave your homes!" advised the *Bhagavata Purana,* a sacred Hindu poetical work written in Sanscrit centuries ago. It was good advice and was still being followed in the 19th century according to a British observer who watched the people of Marwar abandon their homes during the Pali plague of 1836-38.

People in the Chinese province of Yunnan, scene of many outbreaks, were well aware that death among rats was a warning of worse things to come. During an epidemic at Chaochow in 1792, a poet, Shih Tao-nan wrote a few days before he himself died from the plague :

"Few days following the death of rats,
Men pass away like falling walls."

It is thus easy to understand why the idea arose that plague was not a disease of rodents in general, but of rats in particular and that slogans like "No rats—no plague" were widely accepted.

Just the same, the inhabitants of Central Asia, birthplace of great plague epidemics of the past, had known for generations that a fatal, infectious disease periodically attacked the Siberian marmots and that it was apt to spread to man. They had, in fact, taken surprisingly adequate measures to protect themselves against this danger.

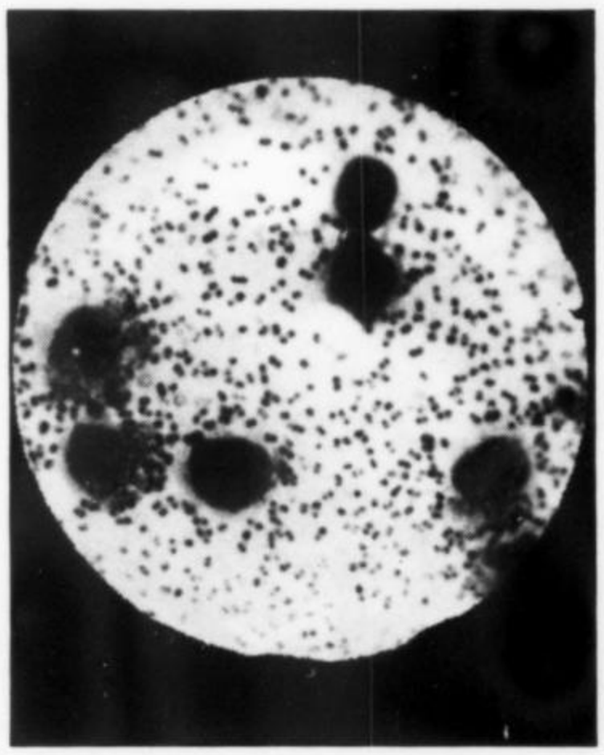
The infection carried by the marmots and among the human beings who had come in contact with them seems to have first been identified with plague in 1895 by two scientists, Bjeliavski and Rjeshetnikoff.

Solved marmot mystery

BUT the evidence collected by these two observers was not supported by laboratory examination, and it was only ten years later that bacteriological proof of the existence of human plague in Tansbaikalia was obtained. In other parts of the world, wild rodents, quite apart from rats, were first suspected and later proved to suffer from plague and to be able to transmit it.

It is generally recognized that the plague bacillus was first discovered by a French Army doctor, Alexandre Yersin, although some authorities credit a Japanese scientist, Shibasaburo Kitasato with this achievement. Yersin who was one of Pasteur's pupils, had an adventurous career. A laboratory research worker by training, he set out for the Far East, became an explorer in Indo-China and found himself in Hong-Kong during the bubonic plague epidemic of 1894. It was here that he made his great discovery which he recounted as follows :

"Before being buried in the cemetery the bodies were left for an hour or so in a kind of cellar. They were already in coffins and covered with quick-lime.



Institut Pasteur, Paris.

Plague bacilli seen through a microscope.

One of the coffins was opened and I removed some of the lime. The bubo (plague boil) was unmistakable ; in less than a minute I had removed it and I went up to my laboratory. I quickly prepared a specimen and placed it under the microscope. At the first glance I made out an absolute swarm of microbes—all alike. They were like very tiny rods, thick, with rounded ends and not very well coloured..."

After having identified this bacillus in both rats and men, Yersin was able to affirm : "The plague is a contagious and inoculable disease. It is probable that rats form the main reservoir."

The early plague investigators in Hong Kong, however, were obsessed with the idea that bubonic plague was primarily a gastro-intestinal infection, and it was not until 1901 that rat destruction was started there, even though this had been recommended by Yersin as early as 1897.

How this question was cleared up by two scientists, M. Ogata, and P.L Simond working independently is told in a monograph on plague by Dr. R. Pollitzer, published by WHO.

Working in Formosa. Ogata assumed that the plague was an insect-borne infection and suspected rat fleas in particular. "One should pay attention to insects like fleas", he wrote, "for as the rat becomes cold after death, they leave their host and may transmit the plague virus direct to man". After inoculating mice with a mixture obtained by grinding up fleas collected from plague rats, he obtained positive results and was able to prove that the fleas had actually absorbed plague virus.

Discoveries ridiculed

SIMOND, a French surgeon working in India, was quite unaware of Ogata's findings when he began his own investigations in 1897. He found that when healthy rats were placed near infected ones (without there being any direct contact) the healthy ones contracted plague. Under exactly the same conditions no infection was transmitted as long as both animals had been freed from fleas beforehand. "On that day, June 2, 1898", wrote Simond later, "I experienced an indescribable emotion at the thought that I had just solved a mystery that had haunted mankind since plague first appeared in the world."

Though the findings of Ogata and Simond were at first ignored or even ridiculed, their scientific accuracy was soon established. Further investigations carried out in all areas where plague became rampant at the end of the 19th and in the early 20th centuries showed that the plague bacillus is constantly present among the rodents, being spread from animal to animal not directly but through their blood-sucking fleas.

They also showed that the danger of the disease spreading to men arises as a rule only at times when the infection among the rodents becomes so widespread that many animals die and thus their fleas are driven by hunger to attack other than their usual hosts, particularly man.

PLAGUE *(Continued)*

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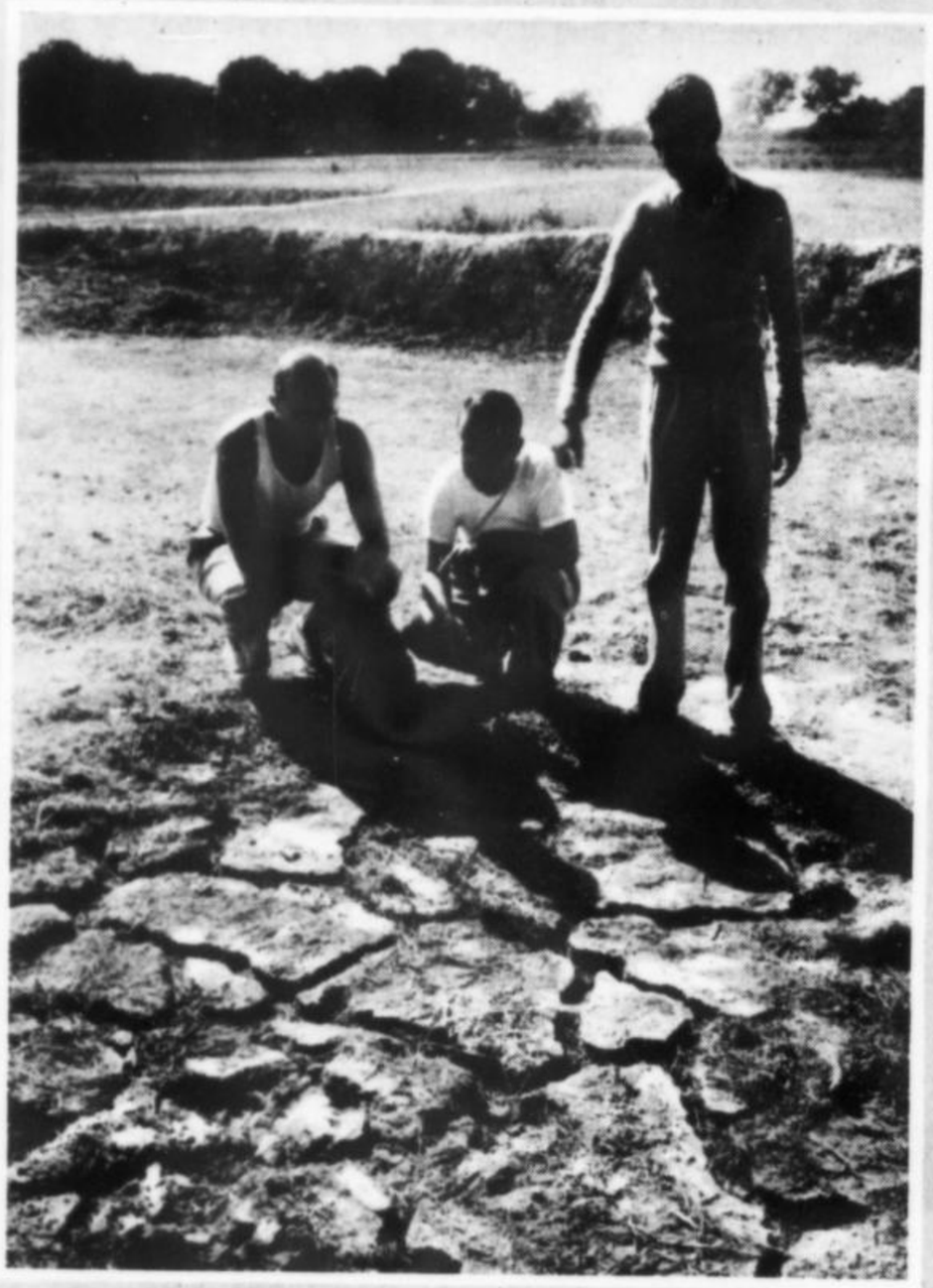

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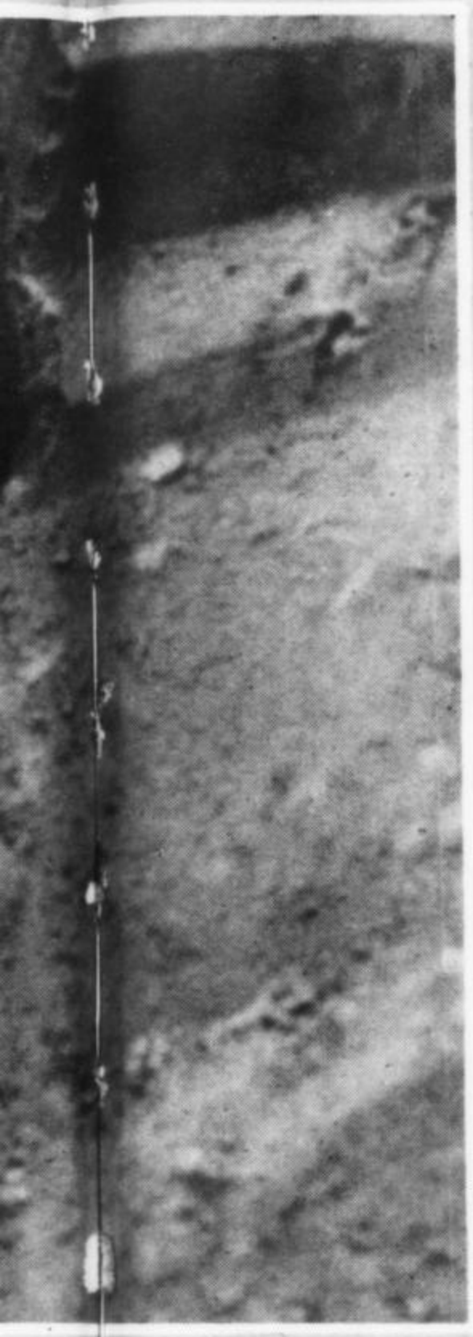

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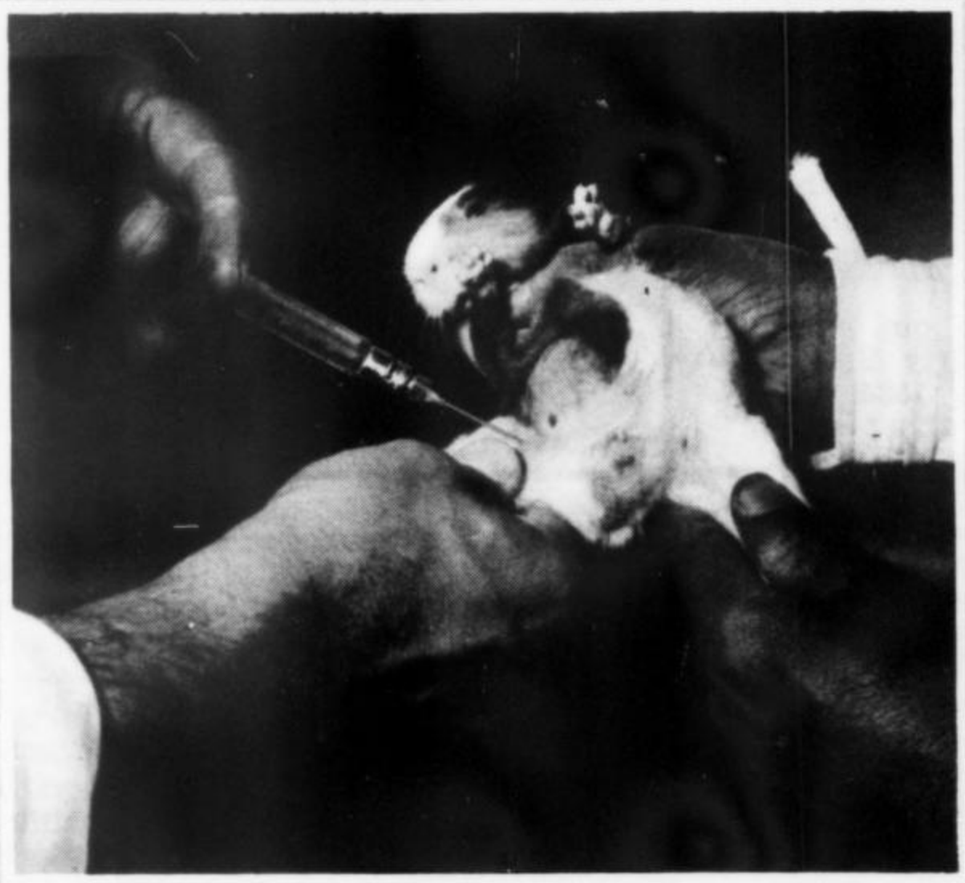

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'BLACK DEATH' LURKS UNDERGROUND

A small brown, furry animal, too common in India to attract much notice has suddenly become the central figure in a research project of international significance. The *Tatera indica*, as this wild rodent is known to zoologists, has become important because of the role it appears to play in spreading and perpetuating a dread disease—bubonic plague, the "Black Death", Evidence linking this seemingly harmless rodent with plague has been collected by scientists in Uttar Pradesh, India, where in 1947, more than 50,000 people died of plague. Latest research suggests that the *Tatera indica*, harbours the disease between outbreaks in its underground burrows. Some of these wild rats have a higher resistance to plague and survive outbreaks which kill off most others, including house rats. They then carry the plague bacilli in their blood and spread infection through their fleas. Laboratory tests, on 5,000 wild rats and several hundred guinea pigs showed researchers that *Tatera indica* was, in fact, the plague reservoir in Uttar Pradesh. Photos tell how research "convicted" this wild rat as a dangerous harbourer of plague. (1-2) When grass is burned away rodents' burrows and "footpaths" are revealed. (3-4) As burrows are dug out a frightened rat tries to escape. (5) Before it can get away a pair of rat forceps have it firmly by the ear and tail. (6) Villagers lend a hand in baiting rat traps. (7) Rat is numbered and released exactly where it was caught. Later catches of marked rats show extent of their movement in village. (8) Guinea pig is injected with organic matter from rats suspected as plague carriers. (9) If rodents were infected a plague abscess appears at the innoculated spot on guinea pig's back.

WHO — Pierre Pittet.

PLAGUE

(Cont'd from page 16)

FORTY DAYS IN THE LAZARET

cases were isolated for thirty, and later forty days in sunny and well-aired "lazarets".

Marseilles followed this example in 1383 and Venice drew up a whole series of model health regulations. By 1438 Venice had appointed health directors who controlled the cleanliness of the water supply. In 1485 the city designated a special magistrate for public health who was endowed with wide powers and duties.

In 1418, during the Hundred Years' War, the plague reappeared in Paris and "in less than five weeks killed off more than 50,000 persons". At the end of the 15th century the discovery of the New World extended European medical knowledge. Doctors now faced new diseases, such as syphilis and yellow fever which caused terrible havoc among the Spaniards, along with plague and typhus.

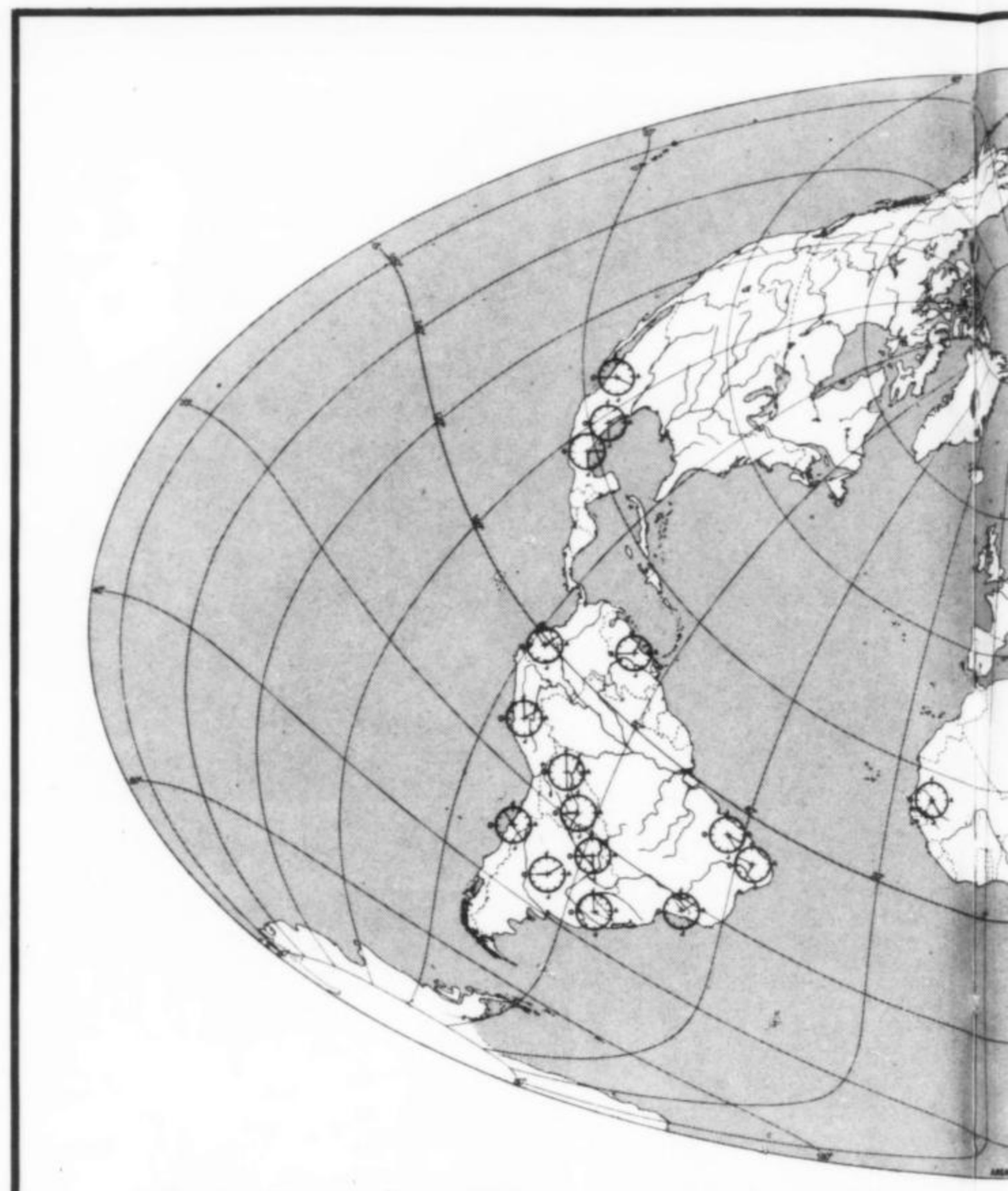
During the siege of Milan, in 1522, the French army commanded by Admiral Bonnivet was attacked by a formidable epidemic of plague which is said to have claimed between 40,000 and 50,000 victims.

In Rome, in 1527, "there was no street that was not heaped with plague-victims, dead or dying, and people imploring Death to put an end to their sufferings." Towards the end of July 1528, the French army encamped before Naples, was decimated by an epidemic (probably typhus) which in less than a month reduced it as a fighting force from 25,000 to less than 100. This was the end of the proud army of Francis I which, as the King's historiographer, Martin du Bellay, wrote, "had dominated Italy, the Romagna and the Kingdom of Naples".

In the following century, the plague broke out once more, this time among the armies of the Thirty Years' War, causing 18,000 deaths at Nüremberg in 1634. At Stuttgart, typhus and the plague held sway for five years, from 1634 to 1639 ; while at Augsburg, a town of 10,000 inhabitants, 30,000 died between 1625 and 1628.

The whole of Germany was scourged alternately by typhus and the plague, spread by rats and fostered by famine, for "the crops in the fields had been entirely eaten up by mice." These disasters drove the people to outright acts of cannibalism ; and attempts to conjure them away led to a wave of religious fervour. Vows were made and processions and pilgrimages took place—especially to Oberammergau, where in 1634 the plague carried off 84 out of 400 inhabitants. This period saw the beginning of the "Passion Plays" which are now performed every ten years in this little village of the Bavarian Alps.

A few years later, in 1657, a Jesuit priest named Athanasius Kirche, announced that the epidemic of plague



Plague "seasons" in different parts of the world circles indicate the number of months—ranging

then raging in Rome was caused by worms so small and elusive that they could not be perceived by the senses. When viewed under the microscope, he said, they resembled objects no larger than atoms. He noted that he had found these small worms in the blood of plague-victims and in the pus of buboes, and that they multiplied in the system exceedingly rapidly.

This forerunner of microbiology believed that the worms were carried by the air, clothing and other objects with which the sick had been in contact, and even in fact by animals. These prophetic views which preceded Pasteur's theories by two centuries naturally strengthened the belief that plague was contagious.

In the early middle ages Christians called on St. Sebastian to protect them from the plague, which they regarded as a form of divine punishment. From the 13th century onwards they appealed to St. Roch who had himself contracted the plague in Italy. These statuettes from a Paris church depict St. Roch showing his plague boil to a doctor garbed in a hood and robe to protect him against infection.

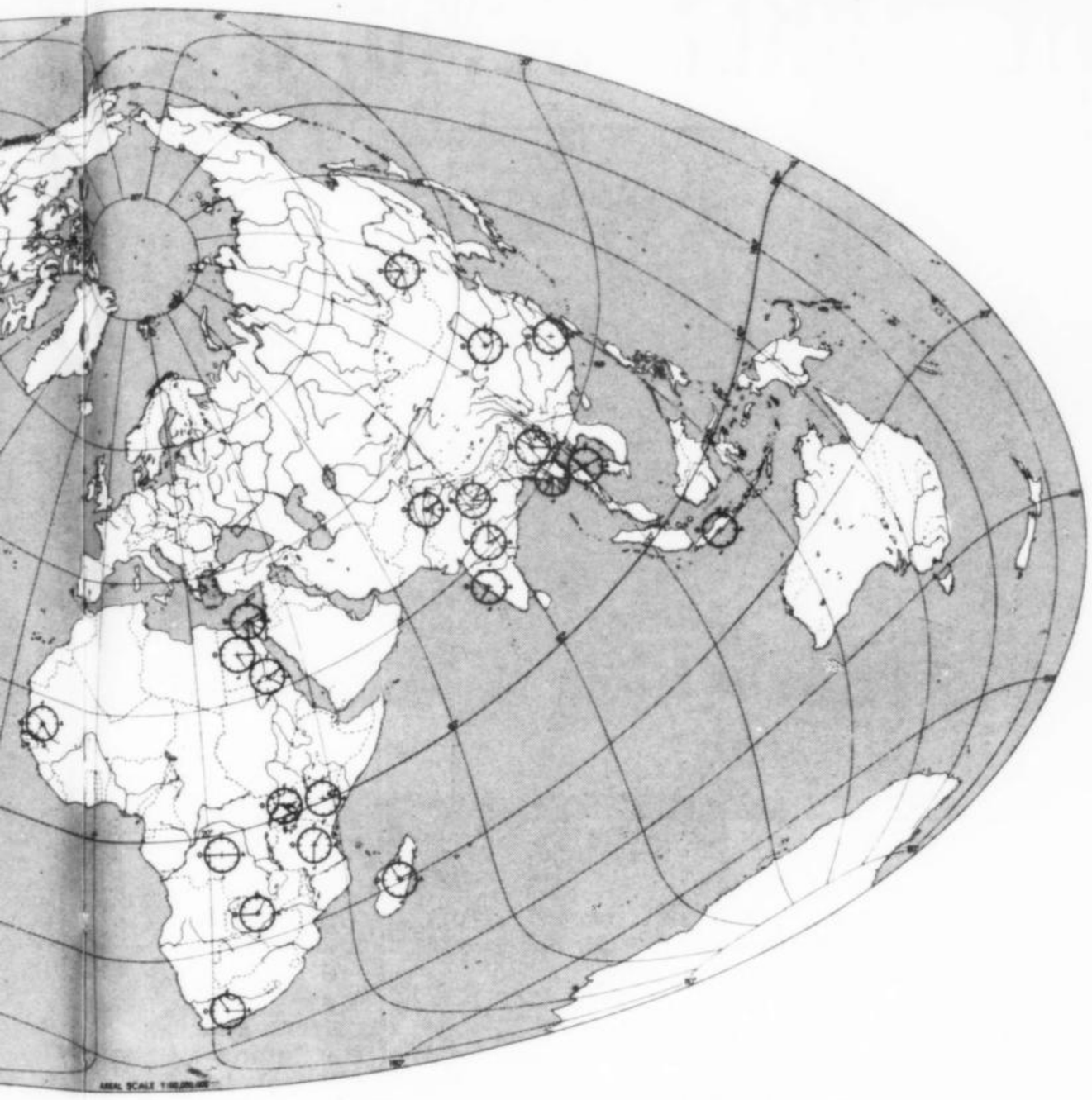
Institut Pasteur, Paris.

Carnavalesque costume and a disinfecting beak

TREATMENT of the disease was mainly governed at the time by an aphorism which had been jokingly baptized "the electuary of the three adverbs"—*cito, longe, tarde*—that is, "early to leave, far away to finish, late to return." The doctors who braved contagion had adopted a special costume, designed in Paris in 1619, comprising a long smockfrock of oiled and waxed cloth together with oiled and waxed taffeta gloves. Louis XIII's doctor improved upon the costume to an almost carnivalesque degree with a leather shirt and breeches of leather, high riding-boots, a full-length coat and gauntlets. The head was completely encased in a leather headpiece with glass protectors for the eyes, while the nose was protected by a sort of large beak filled with disinfectants to inhale.

In France, the first special hospital for the plague-stricken was instituted in 1474 at Lyons. Paris, where 68,000 victims had died at the Hôtel-Dieu hospital during the single epidemic of 1562, established a plague-hospital only at the beginning of the 17th century.

When a terrible epidemic broke out in Lyons in 1628, a health bureau went into operation and was remarkably successful in checking the scourge. From the outset, one



are shown on this map. Shaded sections within the from one to twelve—when cases of plague occur.

hospital equipped with only 200 beds for contagious cases, accommodated 4,000 patients by crowding four or five persons into a single bed.

The declaration of all suspect cases was made compulsory, "health passports" called *bullettes* were issued, and any failure to observe the draconian regulations set up was punished by death. Organized "disinfection teams" worked methodically, fumigating houses and buildings with sulphur, and subjecting all persons released from quarantine to drastic antiseptic cleansing. As a result, the epidemic was throttled in less than six months.

A century later the plague reappeared in Marseilles where unlike Lyons, no health bureau existed. The epidemic devastated the city, raging for years at a cost of 40,000 lives. Many inhabitants fled to Lyons and these plague-spreaders gave the Lyons health bureau another opportunity to prove its worth. Its director, named Goiffon, mobilized his health forces, applied all the prophylactic measures that a century of tests and experiments had perfected and saved his city from disaster.

From then on the advantages of disinfection and "deratting" needed no more proving. Although, at the end of the 18th century, the plague levied a heavy tribute on the French Army in Egypt and decimated Napoleon's troops at Jaffa, its ravages were more or less confined at that time to Eastern Europe and Asia Minor ; and henceforth it did not range beyond Asia and Africa. It was only at the end of the first World War that a slight epidemic struck in the suburbs of Paris but was immediately checked. Of the 137 cases observed only 4 % or so died. Three centuries earlier the plague would have carried off millions of people.

Thus, sanitary measures applied swiftly and methodically to patients as well as to rats and fleas, have succeeded in ridding Europe at least from this terrible scourge which as La Fontaine put it in Louis XIV's time "was able to enrich Acheron in a day."

The above article is taken from Clio en Epidaure *by Dr. G. Barraud, a book devoted to medicine and humanism in ancient times, by permission of the publishers, Editions Sipuco, Paris.*

'PLAGUE SPOTS' AROUND THE WORLD

DURING the Great Plague of London in 1665 a chronicler of the time wrote with grim humour : "Mr. Garancières saith the Plague is the easiest disease in the world to cure, and soe said Mr. Stoakes, the Apothecary... but hee is dead since."

A modern medical writer was recently able to state, "We have vanquished plague as an epidemic scourge." But the same writer went on to warn: "The reservoir of the disease remains because it is not in man himself, and to expect its eradication is Utopian."

This is exactly what Pasteur foresaw in 1881 when he said: "Plague is a virulent disease endemic to certain countries. In all these places its virus must exist and is ready to become active immediately suitable conditions of climate, poverty or famine appear."

In the past half century plague has killed more than twelve and a half million people (according to Dr. R. Pollitzer, author of a World Health Organization monograph on the disease). Half these victims died between 1898 and 1908, and a further quarter in the next ten years. After a temporary increase during the war years (1939-1946) the death rate has again dropped.

Until 1912 it was believed that plague was essentially a disease transmitted to man by the domestic rat (through fleas). Today we know that there are also enormous reservoirs of the disease among some 200 species of wild rodents. These exist in areas of Central and Western Asia, a vast territory of South Africa and some parts of Latin America.

★

ONE of the world's great areas of wild rodent plague is in a huge territory covering some 15 states in the western part of the United States. Here ground squirrels and prairie dogs form the main reservoirs of infection. But there have been practically no cases of human plague in the region since 1924 for these wild rodents live far from human dwellings and their fleas fortunately do not bite men.

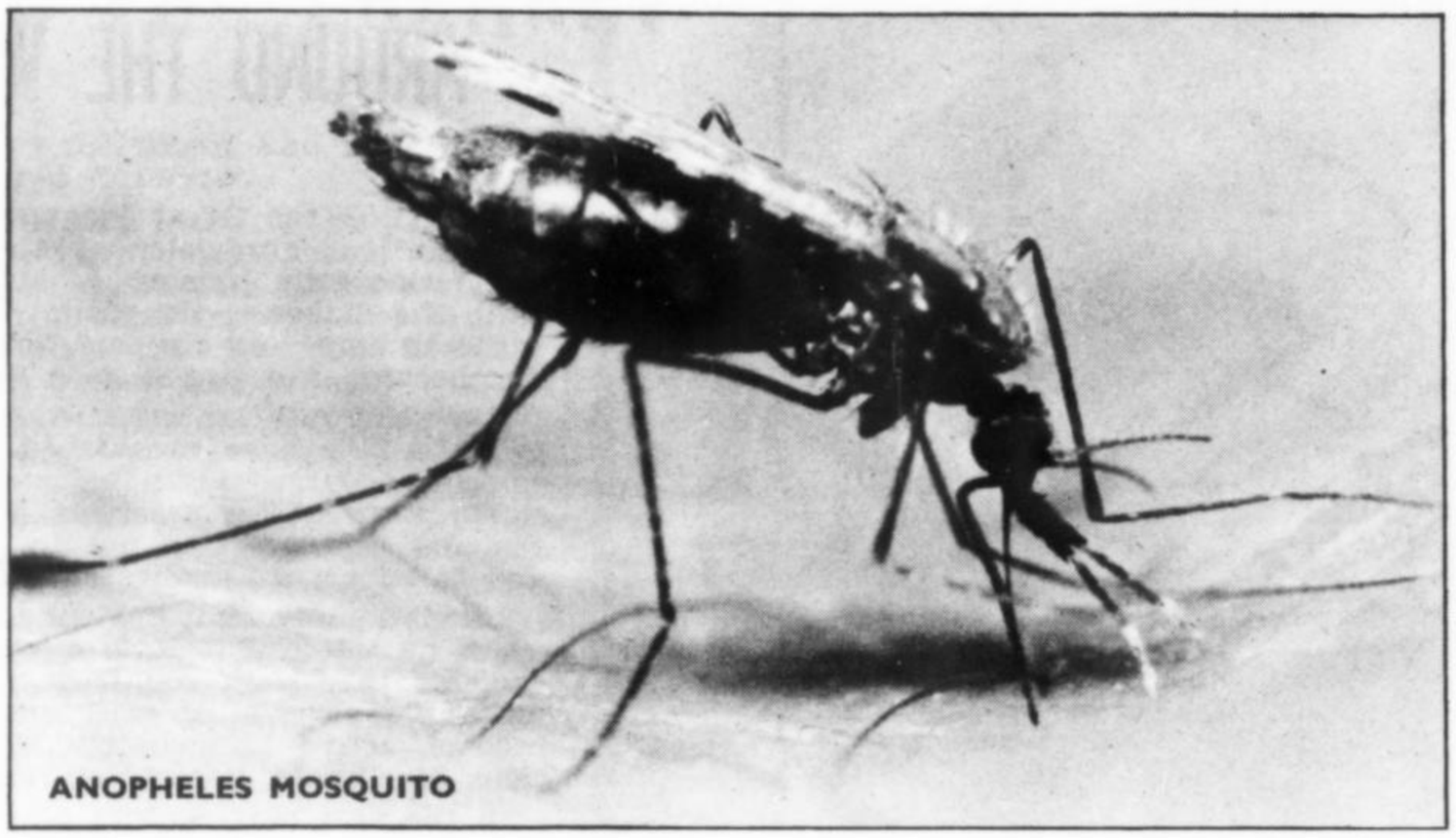
The danger however lies in the wild rodents or their fleas coming in contact with the common house rat which would set off a chain reaction of infection threatening human beings. U.S. health authorities are aware of this danger and along with wholesale wild rodent extermination have created safety zones with rodent-free belts around human settlements.

Scientists have discovered in recent years that seasons, climate and temperature also play an important role in accelerating or reducing the spread of infection. The death rate of flea-infected rats has been found to be high when temperature and air humidity are moderately high. When such a favourable climatic period ends, instances of rat plague become few and far between and human plague ceases until suitable climatic conditions once more usher in a new plague season.

Map shows world's plague areas between 1900-1952. Shading in circles indicates length of plague season—sometimes all year round.

Map copyright 1952, The American Geographical Society The Geographical Review, Vol. 42, N° 4, 1952.

'THE FEVER OF THE THREE DEMONS'



ANOPHELES MOSQUITO

WHO

MALARIA was given its name directly from the Italian "mala" and "aria" literally "bad air". It is a stubborn disease: slow to kill, quick to incapacitate and hard to cure.

It exists widely in populated areas where average temperatures reach 60° F. Since 1920, malaria has been found as far north as Archangel, and as far south as Cordoba in the Argentine. It occurs at mountain altitudes as high as 8,000 feet, and around the Dead Sea, some 1,300 feet below sea level.

★

Of the 300,000,000 estimated malaria sufferers in the world, before present control methods were used, 3 million died each year. Malaria raises mortality, reduces fertility, increases stillbirths. Malaria kills only 1% of those who contract it, but reduces the productive capacity of the other 99 %, and causes heavy financial and economic loss.

★

Malaria is spread by certain types of mosquito. The mosquito absorbs the parasite when it bites and draws blood from a malarial subject. After developing inside the stomach of the mosquito, the parasite is re-injected by the insect into the blood stream of another human being.

★

The world's oldest recorded disease, malaria is referred to in ancient Chinese, Chaldean and Hindu texts. Hippocrates mentions it, and Chinese mythology tells of the fever "of the three demons: one armed with a hammer, the second with a pail of water, the third with a stove"—forceful symbols of the bouts of headache, chills and fever that characterize the disease.

★

The Romans offered prayers and sacrifices to "Dea Fibris"—The Goddess of Fevers—in the hope of escaping infection. They associated swampy areas and even mosquitoes with the disease and built drainage canals as an early form of malariology. By 100 A.D., Columella in "De Re Rustica", advised against building near marshes "that breed animals armed with mischievous stings whereby diseases are often contracted."

★

Fifteen centuries later, in 1632, Spanish explorers and colonists brought back from Peru the bark of the "quina-quina" tree. The quinine it provided was called "cinchona" in honour of the Spanish Countess of Chinchon—celebrated as the first known case of malaria cure. For centuries after, the value of the medicine was obscured because of the confusion between the quina-quina bark and that of similar trees, and by quacks hawking bogus "cinchona" throughout Europe.

★

One of the earliest malaria control projects based on the discoveries of Sir Ronald Ross, of Great Britain, was the clearing of the disease from Staten Island in New York harbour, during 1901.

Throughout the first World War and since, the repression of malaria was widely practised by eradication of the mosquito in the larva stage—usually by drainage works and with oil sprayed on ponds and breeding places. Spray killing of the adult mosquitoes—rather than of the larvae—began in South Africa in 1935, with oil extracts of pyrethum. This same prophylaxis was used during World War II.

UNICEF

MOSQUITO PATROL visits this Costa Rican village twice each year to spray houses and farm buildings with DDT insecticide. Malaria control campaigns in most parts of the world are being aided by the World Health Organization and the U.N. Children's Fund (UNICEF).

★

In 1940, the potentialities of DDT as a fly and insect killer were realized by a Swiss chemist, Dr. Paul Muller. Since then, DDT, together with other insecticides such as dieldrin, has become the supreme anti-malaria weapon of man—it does not kill mosquitoes more efficiently than pyrethum, but it does continue to kill them months after it has been applied to a given surface on which they alight. Therefore, repeated sprayings of the interiors of homes and buildings, where mosquitoes prey on humans, result in killing the insect vector before he can re-infect another person, thus interrupting the transmission cycle.

1

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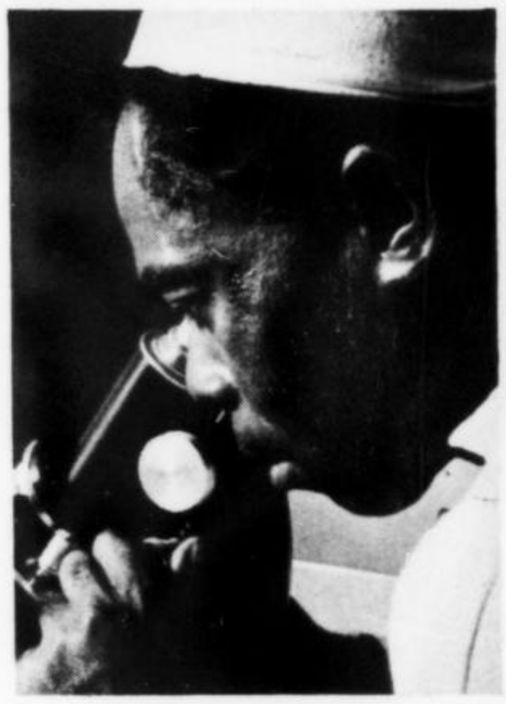
3

MEETING THE CHALLENGE. This is how the challenge of malaria is being met at the Anti-Malaria Experimental Centre near Yaoundé, French Cameroons, set up by the French Government with the aid of WHO and the U.N. Children's Fund. (Photos 1 and 2) Doctor's hands feel a child's spleen. Repeated attacks of malaria cause an enlargement of the spleen and such examinations give an idea of the amount of malaria in a given area. (3) Insect collector at work in local swamp. (4) An African laboratory worker examines blood slides from villages.

WHO - Pierre Pittet



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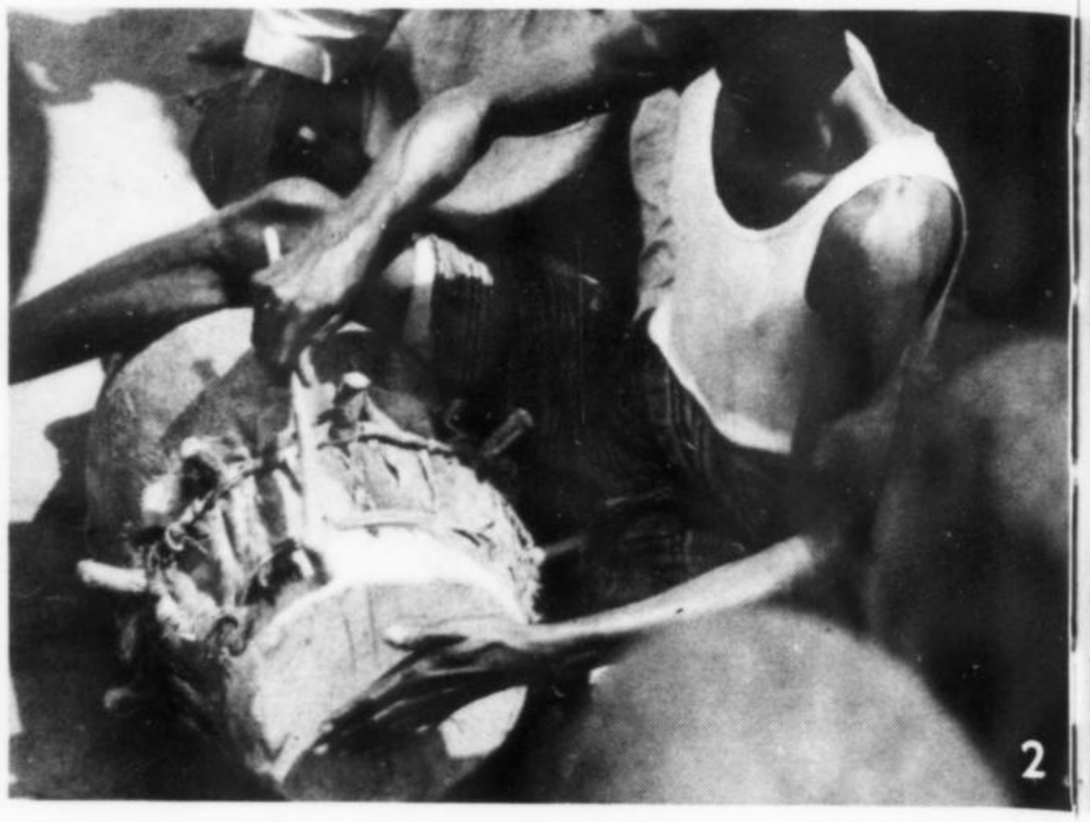
SIR PATRICK MANSON

ON THE MOSQUITO'S TRAIL

THE detective work that exposed the mosquito as the culprit responsible for malaria is one of the great chapters in the history of science. Scientists of many nations have participated in the search. A possible connexion between mosquitoes and malaria was actually made by the ancient Hindu, Susruta. In 1880, Charles Laveran, a French army surgeon stationed in Algeria, discovered the malaria parasite in human blood (he won the Nobel Prize in 1907). A year earlier, Sir Patrick Manson, the great Scottish microbiologist then working as a young doctor in China, had discovered the role of mosquitoes in the transmission of another tropical disease called filariasis which led him to propound the theory that mosquitoes transmit malaria. It is said that Manson proved it was the *Anopheles* mosquito, by allowing his son to be bitten by an infected mosquito and to come down with the disease. The conclusive incrimination of the mosquito, however, came as a result of five years of painstaking work in India by Sir Ronald Ross, one of the most eminent and versatile of modern pathologists, who received the Nobel Prize for his investigations in 1902. On August 20, 1897 (later called "Mosquito Day") he identified the malaria parasite inside the *Anopheles* stomach. A year later Ross had established the entire life cycle of the parasite. His work opened the way to malaria control through the eradication of mosquitoes in the larva stage. Ross recognized that it was "Manson's theory, and no other, which actually solved the problem" of the mosquito transmission of malaria. Working separately in Italy, Prof. Giovanni Battista Grassi brilliantly demonstrated the mosquito's role in 1898. The general problem was advanced in its various stages by pathologists, clinicians and hygienists from other countries.

SIR RONALD ROSS

GIOVANNI GRASSI



'We don't count the dead—we just bury them'

UNICEF

MALARIA—as every self-respecting Dahomey fetichist knows—is simply a stone planted in the heart by an angry god. All the same, rather than risk a contest with the white magic of DDT supplied by the U.N. Children's Fund (UNICEF), the black magic priest-professors of the fetichist school, in the fisherman's village of Houedome, on the Porto-Novo lagoon, marshalled their female pupils—aged two to fifteen—to greet the visiting anti-malaria team with drums and dances **(Photos 2 and 4)**.

To reach this picturesque island settlement, built on stilts in the delta area of the Oueme river, the health team, together with their equipment and supplies, were ferried across in hollowed-out log canoes **(1)**.

The team's itinerary from the mainland to Houedome and other island villages in the Aguegues district, took them through blue lagoons edged by tall waving reeds and across emerald-green flood plain pastures. Here local tribes live by spearing fish and breeding hardy brown cattle penned inside man-made enbankments. Such slow-moving delta waters offer ideal conditions for mosquitoes and almost half of Dahomey's 1,500,000 population living along the coastral strip, is exposed to the constant threat of malaria. In the words of Houedome's headman, when questioned on the malaria mortality rates among children: "We don't count them—we just bury them."

Protection of these people by anti-mosquito spraying with DDT or dieldrin, is part of a general drive against malaria launched by the French Health authorities in French West Africa and in Togoland, and towards which the UNICEF has contributed $ 1,268,000 since April 1952. The people of Houedome and other settlements of the Aguegues area, will be among the 400,000 people due to be protected against malaria in Dahomey, this year.

According to the fetichists, the explanation will be that fewer stones have been planted in the hearts of those that offend the gods—Hebiesso the Thunder, Sakpate the Smallpox, Dan the Rainbow and Ogoun the Almighty.

But just to make sure they too will benefit by this reprieve, the prancing cotton-draped bead-covered trainee witches of Houedome, politely invited the team of "white magic" practitioners to spray DDT over the matting walls of their own academy of black magic **(3)**.

THE LAST REFUGE OF YELLOW FEVER

by Dr. J. Austin Kerr
Rockefeller Foundation

YELLOW fever will invade Mexico within the next few months probably, and almost certainly within a year. This prediction has just come from Dr. Fred L. Soper, director of the Pan American Sanitary Bureau, regional office of the World Health Organization in Washington. Official notification has been received from the Government of Guatemala that dead and dying monkeys are now being found around Lake Izabal and there is evidence of the presence in the region of the yellow fever virus. Yellow fever is now only 75 or 80 miles from the Mexican-Guatemalan border and 800 miles from the U.S. border where the whole southern third of the nation is classified as a yellow fever "receptive area".

In December 1954, Dr. Soper had already warned: "Yellow fever is not a 'dead duck', it has not been conquered, it has not been eliminated as a permanent threat to the United States. It has recently come back to nearby countries where it had been unknown for decades. Yellow fever seems of little international importance or concern until it suddenly appears in a port city as it did in the summer of 1954 in Port-of-Spain, Trinidad. Then the picture changes overnight and interest in the disease as a public health menace is rekindled."

Although yellow fever in cities (carried by Aedes aegypti mosquitoes) has been practically eradicated from most of South America and parts of Central America, another type of the same disease known as jungle yellow fever still exists in tropical jungles attacking monkeys which keep the virus alive. A wave of this jungle yellow fever has been moving slowly but steadily up through Panama and Central America since 1948, reviving old memories of the devastating epidemics that preceded the building of the Panama Canal. The wave reached the north-west corner of Honduras in September 1954. The threat now is that a jungle infected person reaching a port city may spread the disease to Aedes aegypti mosquitoes, starting a chain reaction of urban yellow fever.

ONE the five great pestilential diseases from which mankind suffers, yellow fever, is transmitted to man by certain mosquitoes.

It is a tropical disease, primarily of the shores of the Atlantic Ocean. At its greatest extent yellow fever spread from the Belgian Congo to Spain, France and England in the Old World, and from Buenos-Aires, Argentina, to New York, Boston and even Quebec, in the New World. The disease did make some excursions to the Pacific Coast of the American tropics, but it has never been present on the East Coast of Africa.

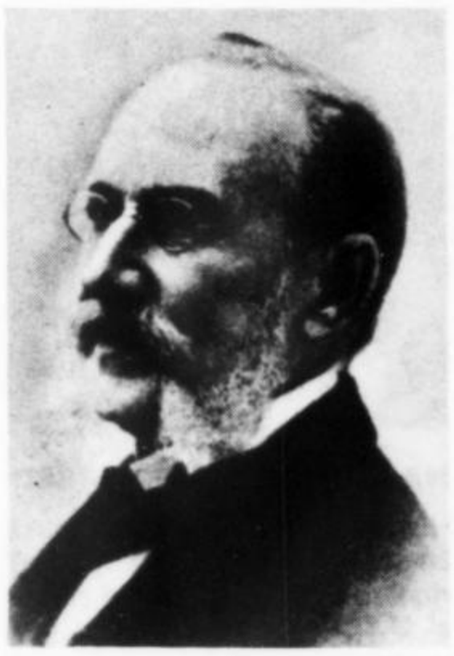
This disease is the "yellow jack" of history. It is a disease of cities, transmitted from man to man by the *Aëdes aegypti* mosquito. The disease was first diagnosed in the Americas but it well may have originated in Africa.

Yellow fever is caused by a virus. The organism is very much smaller than an ordinary bacterium or germ, and is transmitted to man by the mosquito.

No mosquito is ever hatched infected. It has to acquire its infection from some infected person or jungle animal after it hatches.

In 1918 the Rockefeller Foundation became much interested in yellow fever and undertook to eradicate it from the face of the earth. A careful appraisal of the situation at that time resulted in the conclusion that the disease could be eradicated from the earth in 10 years at a cost of $5,000,000. Much work was done, much very successful work, and in 1925 it was thought that the eradication of the disease was in sight. But the next year there was a set-back.

Again, in 1928, the goal seemed to be in sight but in that year there was a more severe set-back in the form of an epidemic of more than 1,000 cases in the city of Rio de Janeiro. In the next few years the development of increasingly effective measures for the control of *Aëdes aegypti* so greatly reduced the amount of yellow fever that it was possible in 1932 to recognize that yellow fever was occurring in the complete absence of this particular mosquito.



CARLOS JUAN FINLAY

The first scientifically based suspicion that mosquitoes might be guilty of spreading disease came in 1881 from Dr. Carlos Finlay of Cuba. He propounded the theory that the tiger mosquito (Aedes aegypti) was responsible for transmitting yellow fever. His theory was confirmed in 1901 by Walter Reed of the U.S. Army, in Cuba.

The Wellcome Historical Medical Museum, London.

The name given to this form of the disease was jungle yellow fever. It has since been recognized to be widespread in South America and in Africa, where it exists permanently in the tropical rain forests of the Amazon Valley and of the Congo River Basin. From time to time epidemics of the disease burst out of these huge central reservoirs.

Jungle Yellow Fever is transmitted to man by the bite of a jungle mosquito. The species of mosquitoes present in the American and African tropical forests are very different in name but not really different in their habits. Both kinds live in the leafy canopy, or top layer of the forest rather than down at the ground level where man spends most of his time.

The distribution of the *Aëdes aegypti* mosquito nowadays is very much more restricted than it used to be because of the presence in all large cities of a supply of piped water, which we take for granted. The mosquito is gone from the temperate regions but it does remain in the tropical and subtropical regions.

From many of the seaports of tropical America, the mosquito has been eradicated; in most of the others it is rather scarce. However, it still remains widespread in the southern U.S.A.

The confirmation by Walter Reed, and his co-workers, of Carlos Finlay's theory that yellow fever was transmitted by the *Aëdes aegypti* mosquito made it possible to eradicate yellow fever from Cuba in 1901 and from the Panama Canal Zone a few years later. With the perfection thirty years later of the techniques for eradicating *Aëdes aegypti* from cities, towns, villages and rural houses in the Americas, it became possible to protect the residents of those non-jungle areas against the disease. Where there were no mosquitoes there could be no yellow fever.

Quite a different situation exists regarding jungle yellow fever, for it is manifestly impossible to control the jungle mosquitoes which transmit the disease to man—and it always will be. Reliance has to be placed on individual protection — by vaccinating against yellow fever the persons who have to

YELLOW FEVER

(Cont'd)

enter the forest and run the risk of contracting the disease.

One of the great mysteries of modern medicine is the fact that yellow fever is not present, and never has been present, in India or in any other place in the Orient.

As a matter of fact it has never been recognized on the coast of East Africa, so that it would appear that the barrier to the eastward spread of the disease lies somewhere inland from that coast.

The yellow fever mosquito (*Aëdes aegypti*) is widespread in the tropical portions of the Orient and among the islands of the Pacific. Furthermore, this whole area is rich in species of mosquitoes which are first cousins of *Aëdes aegypti*.

More important still, some of these species have been shown in the laboratory to be capable of transmitting the disease experimentally from monkey to monkey.

Howler monkeys fell dead from the trees

IN the Americas there have been two episodes in recent years which have been of great interest and importance. The first of these was the epidemic of yellow fever which began in Panama in 1948. In succeeding years it spread northwards through Costa Rica, Nicaragua and Honduras causing cases and deaths each year through 1954, when it burned itself out.

This epidemic was accompanied by a fantastic mortality of howler and spider monkeys in the forests of Central America. In many places the stench of dead monkeys in the forests was overpowering.

With the human population well vaccinated and with *Aëdes aegypti* well under control in the port cities and other centres of population, this epidemic was of relatively little economic importance.

Not since 1925 had yellow fever previously been diagnosed in Central America. In that year some cases occurred in Mexico; and they are considered to have been urban cases transmitted by *Aëdes aegypti*.

In 1920 there is a well authenticated history of heavy mortality of howler monkeys in the forests of Honduras. And in 1882 there is also a very clear story of an epidemic of yellow fever in man in the forests of the Guatemalan Peten. At the time of the epidemic howler monkeys were observed to fall dead out of trees by people still living today.

The second epidemic in recent years occurred in 1954 in Trinidad, British West Indies, where yellow fever had not been diagnosed for 40 years.

By great good fortune, a virus research laboratory which had been set up in Port-of-Spain isolated a virus from a forest labourer who was sick with an insignificant fever. The virus was identified as that of yellow fever.

In the succeeding few months, numerous other strains of yellow fever virus were isolated in Trinidad from men, monkeys and mosquitoes. It is probable that the warning given by the first virus isolation prevented an epidemic in the island's aegypti-infested areas.

It is good to know that a disease which was once one of the great pestilences of mankind has now been brought under effective control. In cities the disease is best controlled by eradicating the mosquito which transmits it. Elsewhere, vaccine is available for everybody who has occasion to enter the jungle and there come into contact with the disease.

MAJOR WALTER REED

His work was among the most important in history of medical research. In 1900 he led group of U.S. Army doctors to Cuba to study yellow fever. At end of series of heroic experiments, with soldiers and doctors volunteering to be injected with the fever germs, he proved that the tiger mosquito caused yellow fever, and made future control of the disease possible.

The Wellcome Historical Museum, London.

Great though the accomplishments have been, there is still much to be done. There should be no complacency in face of the fact that yellow fever virus is solidly entrenched, and always will be, in two enormous tropical areas—the rain forests of the Amazon and Congo River Basins.

The eradication of *Aëdes aegypti* from the entire New World is a practical goal toward which the World Health Organization is working hard. Eradication seems feasible also in certain areas in Africa and Asia, but precise information on certain habits of the mosquito is necessary before a final decision can be made in regard to continent-wide eradication in the Eastern Hemisphere.

OLYMPIC RACES FOR LICE

THE louse is an adventurous vagabond by nature"—that is the considered opinion of Dr. Maurice Mathis of the Pasteur Institute of Tunis, where Charles Nicolle discovered the transmission of typhus fever by the body louse in 1909.

Dr. Mathis, author of a book on the Life of the Louse, has written extensively about the habits of this highly repulsive parasite and this is what he has to say about the louse as a Marco Polo of the insect world:

"Despite its size and its extremely inadequate means of locomotion, the louse likes to travel. A scientist, G. Nuttall, has investigated the prowess of the louse as a traveller by organizing 'louse races'.

"Selected lice ran over horizontal and vertical courses and paths at a 45 degree angle. The race tracks themselves were composed, in turn, of black stain, smooth cloth, rough cloth, or one or two hairs. In other words, Nuttall organized a rather strange form of Olympic Games.

"Here are the records of a few champions:

Body Louse Events

1. 12 inch flat race: 49 sec.
2. Same distance on black satin at 45 degree angle: 2 min. 53 sec.
3. Same distance on rough cloth at 45 degree angle: 2 min. 51 sec.

Head Louse Events

Vertical climb on a hair 8 inches long: 1' 25", a record set by a female. The best time clocked by a male over the same distance was 25" longer.

Downhill Schuss

Record held by a male over the same distance as the vertical climb: 2' 46". But the champion, after a day of fasting, refused to run the same course in less than 8' 57". He then proceeded to play the prima-donna by refusing to run at all even after careful feeding.

Open Events

In all races in this category, the body lice were beaten at every turn. Over one distance, the best head louse registered 5' 54" as compared to 8' 12" for the champion body louse.

Best Hour's Run

The records, as reported by A.D. Peacock, are:

1) On a horizontal surface: 4 feet, 7 inches.

2) On a vertical surface: 11 and 1/2 inches.

"These experiments were not carried out for the sake of amusement. They enable us to understand how lice travel from one individual to another. The times and distances recorded by the average louse give us the key to all possible forms of contamination by lice, especially in crowded dormitories."

Queries from the insect world

Are insects sick with the diseases they carry?

DOES an insect carrying a human disease get sick itself? Is the *Anopheles* mosquito, whining through the hot darkness, as sick as the person from whom it got the malaria parasites it is loaded with? The malaria parasites will be multiplying in its stomach, then boring through the stomach walls, developing and dividing in the abdominal cavity, swarming through the body, and finally reaching the salivary glands, from which they are ready to penetrate with the mosquito's saliva into the next person it bites.

This seems to be a lot for a mosquito to carry, and yet it does not appear to suffer much from such an invasion. Laboratory observations on mosquitoes infected with malaria have shown that there is little difference, if any, between their life span and that of non-infected mosquitoes. Other diseases, like yellow fever, often lethal to man, seem to have no harmful effect at all on the mosquitoes infected with them. The *Aëdes aegypti* carrying yellow fever is a healthy creature, though the virus of the disease is found throughout its body.

Can mosquitoes get elephantiasis?

IT is only when carrying diseases like filariasis that mosquitoes suffer heavily and even die. Filariasis is the name given to an infection with tiny parasitic worms called filariae, and is the basic cause of the condition known as elephantiasis. When sucking blood from an infected person, à *Culex fatigans* mosquito may receive such a massive infection that it cannot survive the resulting damage to tissues and disruption of its organs.

Other insects can also be killed by germs pathogenic to man. The rat flea which spreads plague may die when its gut gets blocked with a massive multiplication of the plague bacteria.

But these are exceptions. On the whole, insects are not sick from the disease they carry to man and, if they are, they seem to suffer only from the mechanical effects of massive infection.

How can a killer save lives?

IT has been estimated that five million deaths and 100 million illnesses were prevented by the use of DDT for controlling insect carriers of disease between 1942 and 1954.

What are 'Q' fever and scrub typhus?

AMONG the diseases spread by insects are several caused by tiny organisms called *Rickettsiae*. They can barely be seen under an ordinary microscope, and thus fall between the larger bacteria and the smaller, sub-microscopical viruses. For example, a *Rickettsia* is responsible for classic typhus fever which in the past has killed millions of people during raging epidemics in different parts of the world. It is transmitted by the body louse. Murine typhus, a similar but much less common disease is harboured in rats and is transmitted to man by the rat flea.

Scrub typhus, also known as Japanese River fever or tsutsugamushi fever, is a rickettsial disease of man in the Far East, transmitted from wild rodents by a small mite. Q-fever, which causes a pneumonia-like disease in man, is often carried by ticks between domestic animals, from which man obtains the disease by the airborne route.

Do ticks ever attack human beings?

ROCKY MOUNTAIN spotted fever in the United States, and boutonneuse fever seen around the Mediterranean, are sicknesses that man catches from ticks which infest dogs. Tularemia, another rickettsial disease of man, is perpetuated in nature by ticks infecting rabbits and other small wild animals. It is interesting to note that ticks also transmit certain blood diseases, resembling malaria, amongst domestic livestock and cause enormous economic losses. Fortunately, this group of diseases is not transmissible to man.

What insect-borne disease resembles polio?

THE tick pest is also responsible for infection in man of a group of viruses which cause encephalitis (inflammation of the brain). Foresters and rural folk in central and south-eastern Europe are not infrequently infected with this disease, which may somestimes be confused with poliomyelitis. It apparently finds its reservoir in wild life and is transmitted to man through tick-bite.

Although it is probable that meningo-encephalitis (to give it its full name) has existed for many years, it was not until 1946 that it was recognized in Slovenia as a form of meningitis. In 1953 serious epidemics occurring simultaneously in Yugoslavia and in Austria created widespread medical interest in this disease. No specific cure has yet been found. The existing antibiotics have no effect. Recovery in paralytic cases, however, is somewhat more frequent in meningo-encephalitis than in polio, and the proportion of deaths from this disease is somewhat less than in polio : 4.6 % deaths in meningo-encephalitis as against 6.8 % in poliomyelitis.

What causes 'Oriental sore'?

LEISHMANIASIS, a disease in man caused by a protozoa (one-celled parasite), causes "oriental sore" and "kala-azar" amongst large numbers of the poorer population groups in the Mediterranean and South-east Asian areas. Certain species of small flies transmit this disease, and one of its reservoirs is the dog, although man-to-man transmission by the fly is the usual chain of infection.

How fast can mosquitoes bite?

IN Canada, in some of the badly infested northern areas, as many as 280 mosquito bites a minute have been counted on a bare forearm. At this rate a naked man would theoretically be drained of his blood in one hour and 45 minutes.

Is myxomatosis also carried by insects?

CAREFUL investigations in Australia have shown that myxomatosis is spread from rabbit to rabbit by the bites of a number of insects. The most important is thought to be a species of anopheline mosquito which goes down into rabbit burrows to shelter from the heat and dryness of the summer days, and prefers biting rabbits and other grass-eating animals. Further carriers of the disease are some other species of mosquito, certain blackflies (simulium) as well as rabbit fleas and lice.

Radio-isotopes now answer the question:

HOW FAR DOES A FLY FLY ?

by Dale W. Jenkins
National Research Council, USA

If babies or young children in any country were being blinded or killed by human enemies no effort would be spared to put the enemy out of action. Yet flies, which do exactly these things, are treated merely as a nuisance and not as a deadly menace capable of transmitting dysentery, diarrhoea, severe eye inflammations, typhoid fever, cholera and many other diseases. Little progress is, in fact, being made in the control of diseases caused by flies in most of the world. One reason is that too much faith has been placed in insecticides while the real basis of fly control—sanitation—has been neglected. Today, with radio-isotope "tracers" we have a new weapon to fight insects which bring disease. In the article below, Dale W. Jenkins, one of the delegates to the Geneva Conference on Atoms for Peace, describes the new fields opened today by "tagging" insects to follow their activities more easily.

NUCLEAR energy has provided a valuable new tool which has permitted real progress in studying difficult entomological problems. The exact part played by insects in the dissemination of certain diseases is still obscure, and use of radio-isotopes provides a means of clarifying some of these relationships. Labelling of medically-important insects with radio-isotopes was initiated in 1949 by the author and others. Since that time extensive studies have been carried out, using this technique on a variety of insects.

Radio-isotope tagging is an efficient method since it permits positive marking and identification of large numbers of insects with a minimum of labour and cost. For example it is of importance, if control methods are to be efficient and effective, to know how far such insects usually travel ("dispersal range" is the technical term), since this helps us to understand their role in spreading an epidemic.

Various species of mosquitoes have been labelled by growing the larvae in radio-active solutions of phosphorus 32, Strontium 89, and thorium, and releasing the radio-active "marked" adults in large numbers. The dispersal of 10 species of tropical and arctic mosquitoes has been studied by various investigators who have found dispersal ranges of from 1 to 34 km. The yellow fever mosquito in Nigeria was found to disperse up to 1.2 km.

Dispersal and flight range (the maximum distance which can be travelled) of houseflies have been subjects of study for a long time and a variety of marking techniques have been used. Most of these studies showed effective dispersal of 2 km or less. A number of studies of dispersal of the housefly have been carried out using phosphorus 32 and effective dispersal ranges were found to be 1.6 to 13.6 km with *maximum* dispersal up to 32 km. Dispersal studies have also been carried out using radio-active blowflies, screw-worm flies, eyegnats, blackflies, and cockroaches.

Radio-isotope tagging has also helped to find out the total number of one kind of insect there is in a given area, how long certain disease-carrying insects live, and how many offspring they have .

Studies of the disease-carrying role of insects, using radio-isotope marking during epidemic outbreaks, have not been made, but several preliminary experiments of this type have been carried out. In a city in the Crimea, houseflies were studied in their relation to carrying diseases from outdoor privies. Radio-active flies were collected in traps in kitchens in houses 30 metres from the outdoor privy. In Texas, radio-active fruit flies were found by the US Public Health Service in houses 320 metres away from privies containing phosphorus 32 baits.

A large number of fruit flies which were found in houses had at one time or another frequented privies. These results should be borne in mind in relation to outbreaks of dysentery and poliomyelitis.

Another very promising and fertile but unexplored field awaits investigators using radio-isotopes in studying disease transmission by insect carriers. If the organisms which produce a given disease can be tagged, many experiments are possible in tracing them through the insect carrier and determining the sites and numbers of disease organisms which are disseminated.

A large number of disease-producing organisms have been labelled with various radio-isotopes. These include bacteria causing plague and tuberculosis, dysentery, influenza and other viruses, trypanosome sleeping sickness, malaria, and also a variety of nematode (thread-like) worms.

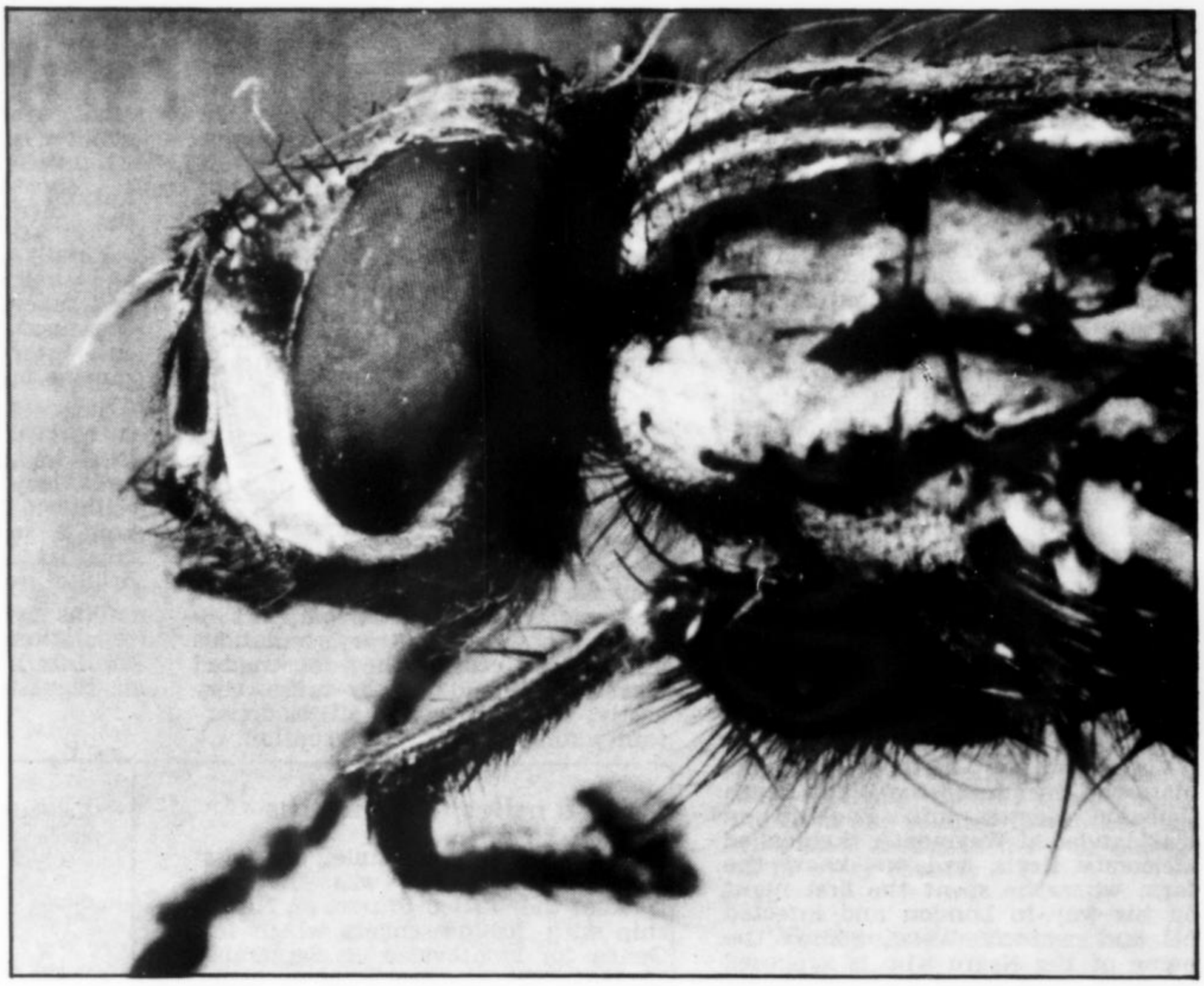
Use of radio-isotopes offers a technique for studying medically-important insects from the point of view of their ability to carry disease, their feeding habits, and the dissemination and numbers of organisms, or size of infective dose of organisms that they can introduce.

The habits, life histories, and disease-spreading role of many important body parasites living on animals are not fully known. Ticks, mites, lice and other medically important parasites of this kind have not been made radio-active and this is a most hopeful field of investigation. Use of this technique should provide needed information on the length of time such parasites remain attached to their hosts under natural conditions, whether they change to other hosts, where they are located while unattached, longevity, dispersal, and population size. Tagging of the parasites is simple since the creature on which they live can be made radio-active as desired.

White rats and rabbits, for instance, were injected with phosphorus 32 so that mosquitoes would take up 1,000 c p m (Geiger counts per minute) of this isotope per blood meal. Similar results were obtained by other workers. Phosphorus 32 has been used to find out just how much blood fleas and mosquitoes take up at a "meal".

Control of insect disease carriers provides a constant challenge, since almost every effort by human beings results in a counter-move by the insects. The widespread use of newer residual insecticides has resulted in the development of resistance, which requires use of greater quantities of more effective new insecticides.

Radio-isotopes provide a tool for furthering basic



THE POISONER IN YOUR HOME. Of all the world's insects, the one most intimately associated with man is the common house fly which shares his home. Because of its capacity to spread disease and its ready appetite for both filthy and clean foods—and its unpleasant habit of moving back and forth between them—it is, in fact, one of man's deadliest enemies. Modern insecticides were thought to be weapons which could control if not completely eradicate the fly. (Photo, opposite page shows flies killed by ten milligrams of DDT in six to eight hours). But health authorities now report that flies are rapidly developing a resistance to insecticides to a degree that makes them ineffective as a single means of control.

WHO

research on control of disease-carrying insects and disease organisms. More than thirty different insecticides have been radio-actively labelled. Radio-isotopes have already been of great use in studying the site of entry, mode and site of physiological action, and generally what happens to an insecticide when it gets inside an insect. Radio-isotopes have also been used in studying the resistance to insecticides of certain insects.

Assessments of the area covered by airplane sprays of insecticides and other materials have been made by the author using radio-active gold. This technique has several advantages over dye tracers in assessing the results of airplane spraying of insecticides. These are, greater accuracy, shorter time for assessment, fewer staff required, and ability to measure depositions on vegetation and uneven surfaces. This technique should be utilized in assessing the efficiency of generators of insecticide fog and smoke and other methods of insecticide dispersal.

Radiation from certain radio-isotopes and X-rays is also proving valuable in controlling or killing insect disease-carriers, disease organisms, and parasites. Large stores of highly radio-active reactor wastes may be made available in the future which have great potential value for this purpose. Eradication of the screw-worm flies was accomplished in Curacao and is being planned in the south-eastern United States. Many papers have appeared on X-irradiation of fruit flies and other insects.

Radio-isotope radiation offers a possible means of killing or arresting development of disease organisms in the animal host body due perhaps to the large uptake of metabolically active elements by these organisms. Ingestion of phosphorus 32 by mosquitoes arrested development of malaria parasites during the oocyst stage.

Red blood corpuscles carrying malaria parasites were shown to take up more phosporus 32 than normal cells, probably due to a more active rate of metabolism. Two varieties of radio-iron have also been used in studying malaria. Three species of trypanosome protozoans causing sleeping sickness became non-infective or were killed when treated with radiation from radium and X-ray. Numerous studies using radio-isotopes have been carried out in attempts to control or reduce infections due to a variety of bacterial and viral diseases, and this field holds great promise.

Super race of insects developing

A super race of insects resistant to all types of insecticides is developing in many countries, a World Health Organization report now reveals. Thirty two countries have reported insect resistance to DDT and other new insecticides, and approximately 35 species of insects are already involved. A number of these insects spread some of the world's most dangerous epidemic diseases.

Various types of malaria-bearing mosquitoes show immunity to DDT in some areas of Greece, Lebanon, Indonesia, Saudi Arabia, Panama, and Mississipi (USA). Body lice spreading typhus can no longer be controlled by DDT in Korea, and five other countries report that satisfactory control is becoming difficult. Fleas which are responsible for plague are manifesting resistance in certain parts of South America.

Worse still, there has recently come from Trinidad information that a strain of mosquito which spreads yellow fever has shown itself to be extremely resistant to DDT. (Trinidad had an outbreak of yellow fever 21 months ago.) As to flies their destruction with DDT and other chemicals is no longer possible in almost all countries where these materials have been used in recent years. Resistance of cockroaches and bedbugs is also well established in many countries.

"Should the degree of resistance in insects transmitting diseases such as malaria, yellow fever, plague and typhus reach the point where control by the available insecticides is no longer possible, disastrous results from a health viewpoint will inevitably occur in many parts of the world", WHO director M.G. Candau recently informed a World Health assembly in Geneva.

Although new insecticides are available they are too few and too limited in efficiency to have a significant effect on events.

An extraordinary fact is that no scientist today can yet say with certainty "what causes death when insects are exposed to insecticides" and what the biochemical and physiological bases of resistance really are. A survey of the research on resistance is at present being carried out by WHO.

DISEASE KNOWS NO FRONTIERS

by Dr. Neville M. Goodman

MAN'S first concept of disease was that it was a punishment of the gods. This attitude is still found among primitive peoples and traces of it can be detected even in our own sub-conscious minds.

The Greeks made the first great step forward—in this as in so many other fields—when Hippocrates and his followers began to consider diseases as natural phenomena which could and should be studied like any other occurrence in nature. The very title of his most famous work, "Airs, Waters and Places" shows his rational and scientific approach.

It was then quickly realized that a large group of diseases, which we now call epidemic, infectious or contagious, could be spread from person to person, community to community and country to country.

We know, for instance, that the man who introduced the Black Death (bubonic plague) into England in 1348, landed at Weymouth, then called Melcombe Regis, and we know the farm where he spent the first night on his way to London and infected his first contact. We also know the name of the Negro who is supposed to have introduced smallpox into Mexico in 1520, thus being responsible for perhaps three and a half million deaths.

The next step was for communities to attempt to isolate themselves from infection or to isolate the infected area, by various means such as establishing *cordons sanitaires* and preventing all ingress or egress. This policy failed even with the most barbarous penalties such as "breaking the head of a man who attempts to escape, as an example to his neighbours".

'A box of old cloathes'

EVEN under medieval conditions, complete isolation was a practical impossibility, though one striking exception occurred when the village of Eyam, in Derbyshire, England, infected with plague from a "box of old cloathes" which arrived from London on September 3, 1665, *voluntarily* isolated itself for thirteen months, by which time 259 out of the 350 or so inhabitants had died.

In the fourteenth century, the Republic of Venice, often infected with plague from its trade with the Levant, conceived the idea of holding the crews, passengers and goods of ships coming from infected countries, in isolation for a limited period, to cover—as we should now say—the incubation period of anyone infected and to allow disinfection of goods by exposure to sunlight or other means.

This period was arbitrarily fixed at forty days—said to be derived from the time Jesus spent in the wilderness —and hence these measures came to be called "quarantine" from the Italian *quaranta*, i. e. forty.

This idea caught on, and similar systems of quarantine were adopted by the ports of most maritime countries over the next three centuries or so; the introduction of infection was thus sometimes prevented and at least it showed that the authorities were taking action.

But by the nineteenth century, with the great expansion of trade and travel made possible by the steamship and railway, these quarantine systems had become an intolerable nuisance. They varied from port to port and were arbitrary, vexatious and often cruel; they obstructed travel and trade; they were very costly; and they gave limitless opportunity for bribery and corruption.

78 miles in 4 months

AN excellent example of *folies quarantainaires* was the case of the *Matteo Bruzzo*, an Italian ship with 200 passengers which left Genoa for Montevideo on September 30, 1884. Cholera broke out on board on arrival at Montevideo and the ship was refused *pratique* there and at Rio. It returned to Italy and performed its quarantine at the island of Pianosa near Elba. The ship finally put in at Leghorn and the passengers disembarked, having taken nearly four months to travel from Genoa to Leghorn, a distance of 78 miles.

Eventually the representatives of twelve European countries met in Paris in 1851 to try to bring about some order and uniformity in quarantine measures, and from this conference the whole modern apparatus of preventing the spread of disease across frontiers—indeed all international co-operation in the field of health—may be said to have sprung. For the next seventy years in fact, international health *was* quarantine.

It took, however, another ten international Sanitary Conferences spread over fifty years before the first effective convention was signed in 1903. This dealt with cholera, plague and yellow fever, to which were added in later conventions, smallpox and typhus—together sometimes known as the "quarantinable diseases" or "Big Five". (In 1952, louseborne relapsing fever was added to the quarantinable diseases.)

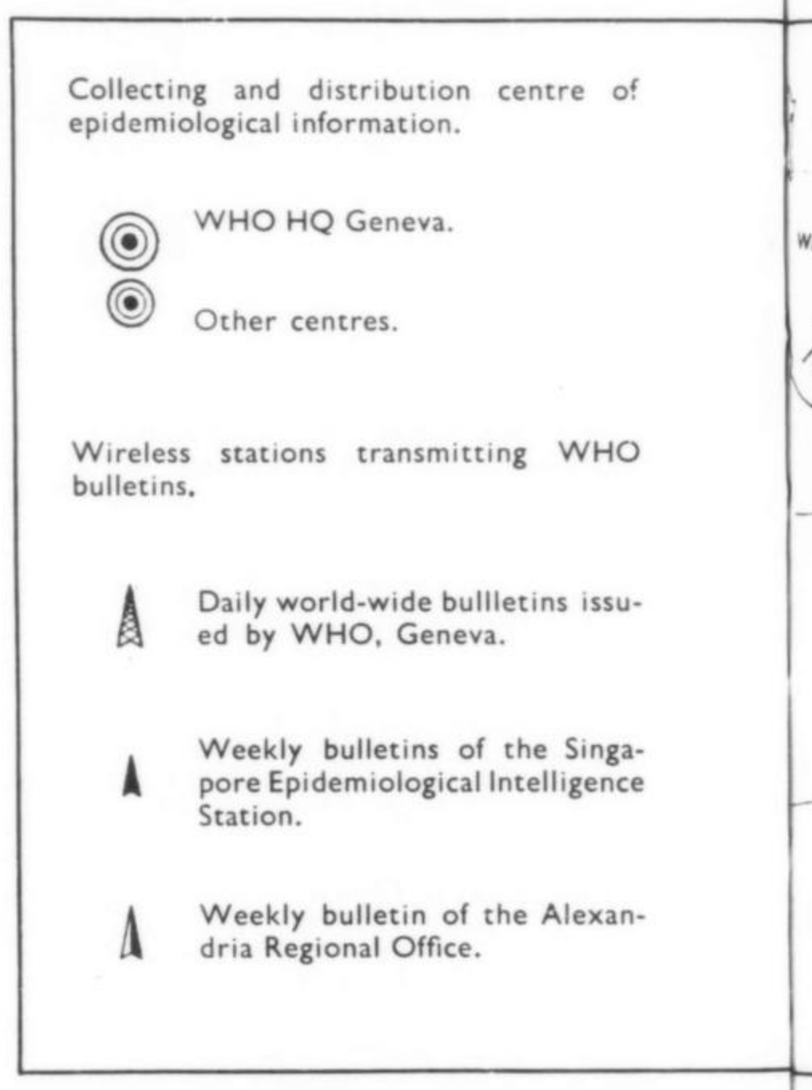
The next step was the creation of international bodies to settle disputes, prepare new conventions in the light of advances in medical knowledge and, above all, to receive and transit information of outbreaks of disease, since early and accurate information is essential to effective quarantine.

These were the Pan American Sanitary Bureau (Washington 1902) and the International Office of Public Health (Paris 1907). Later the Health Organization of the League of Nations (Geneva 1923) and, during the last war, UNRRA also helped.

Finally, about 1948, all these bodies and their work were absorbed into and taken over by the World Health Organization, which is today the only international authority on quarantine matters.

The actual work of "quarantine" is carried out by the central and local health authorities and the sea and airport authorities of each country. International traffic by land is seldom the subject of health measure: control is too difficult and results are hardly worth while.

This is done under governmental regulations which must conform to the international codes, conventions or regulations to which the country


Collecting and distribution centre of epidemiological information.
WHO HQ Geneva.
Other centres.
Wireless stations transmitting WHO bulletins.
Daily world-wide bullletins issued by WHO, Geneva.
Weekly bulletins of the Singapore Epidemiological Intelligence Station.
Weekly bulletin of the Alexandria Regional Office.

is signatory. The code in operation since 1952, accepted by some 90 countries, is contained in the International Sanitary Regulations.

The role of WHO is twofold: on the one hand to draw up, interpret, administer and, when necessary, amend the International Sanitary Regulations, which it does through a Technical Committee on International Quarantine (Chairman, Dr. M. T. Morgan, United Kingdom); and on the other to receive, collate and distribute information on the occurrence of these pestilential diseases. This is done by the WHO staff at its headquarters in Geneva and in three main sub-centres, at Singapore, Alexandria and Washington.

Some 7,000 reports are sent in each year by national health administrations of 170 countries and territories, and the information thus received is

broadcast daily in English and French from Radio Nations at Geneva and the other centres: by arrangement with other stations, these messages are rebroadcast over a wide area. This is supplemented by telegrams and a printed bulletin, the Weekly Epidemiological Record. It should be mentioned that WHO's Epidemiological Information Service is not limited to the six major pestilential diseases, and in a montly Epidemiological and Vital Statistics Report the occurrence and trends of other infectious diseases such as poliomyelitis, influenza, diphtheria and scarlet fever are reported and analysed. In addition, other cognate work is undertaken, such as revising the International Certificates of Vaccination, and de-ratting certificates for ships.

Annual reports are also collated on the health condition of the Mecca Pilgrimage—always a potential source of danger, since up to half a million pilgrims coming from every part of the Old World are crowded annually for a few weeks into the Holy Places in Saudi Arabia. This made the Pilgrimage a frequent source of world-wide epidemics of cholera in the nineteenth century.

Thus WHO is enabled to keep its finger on the epidemic pulse of the world and to keep its member countries informed of the patient's condition. By reducing the international spread of disease and, on the other hand, by preventing excessive or hysterical restrictions on health grounds, WHO is favourably affecting the lives and health of all of us.

Finally, something may be said of the trends and tendencies of quarantine practice today. Originally, quarantine measures were arbitrary and empirical, since little was known about the way these diseases spread.

Once it was established that, for instance, cholera occurred primarily from the excretal contamination of water, that plague was spread by fleas of the black rat and yellow fever by a particular mosquito; and when, later, effective control measures, using modern insecticides and immunizing inoculations had been developed against these diseases, agreement could be reached on more rational measures.

Instead of shutting up people in isolation for arbitrary periods if they were suspected of coming from infected places, today the emphasis is on getting their co-operation and warning them (and their doctors) if they fall ill after arrival of the possibility that they may be suffering from one of these diseases.

Thus, the passengers on a ship coming to London from Calcutta, where smallpox is prevalent, without any suspicious cases having occurred during the voyage would not normally be subject to any restrictions. But if a case of smallpox occurred on board, vaccination would be offered on arrival—if that had not already been done—and everyone would be put under "surveillance" i. e. notified to the Medical Officer of Health of their destinations and told to see him.

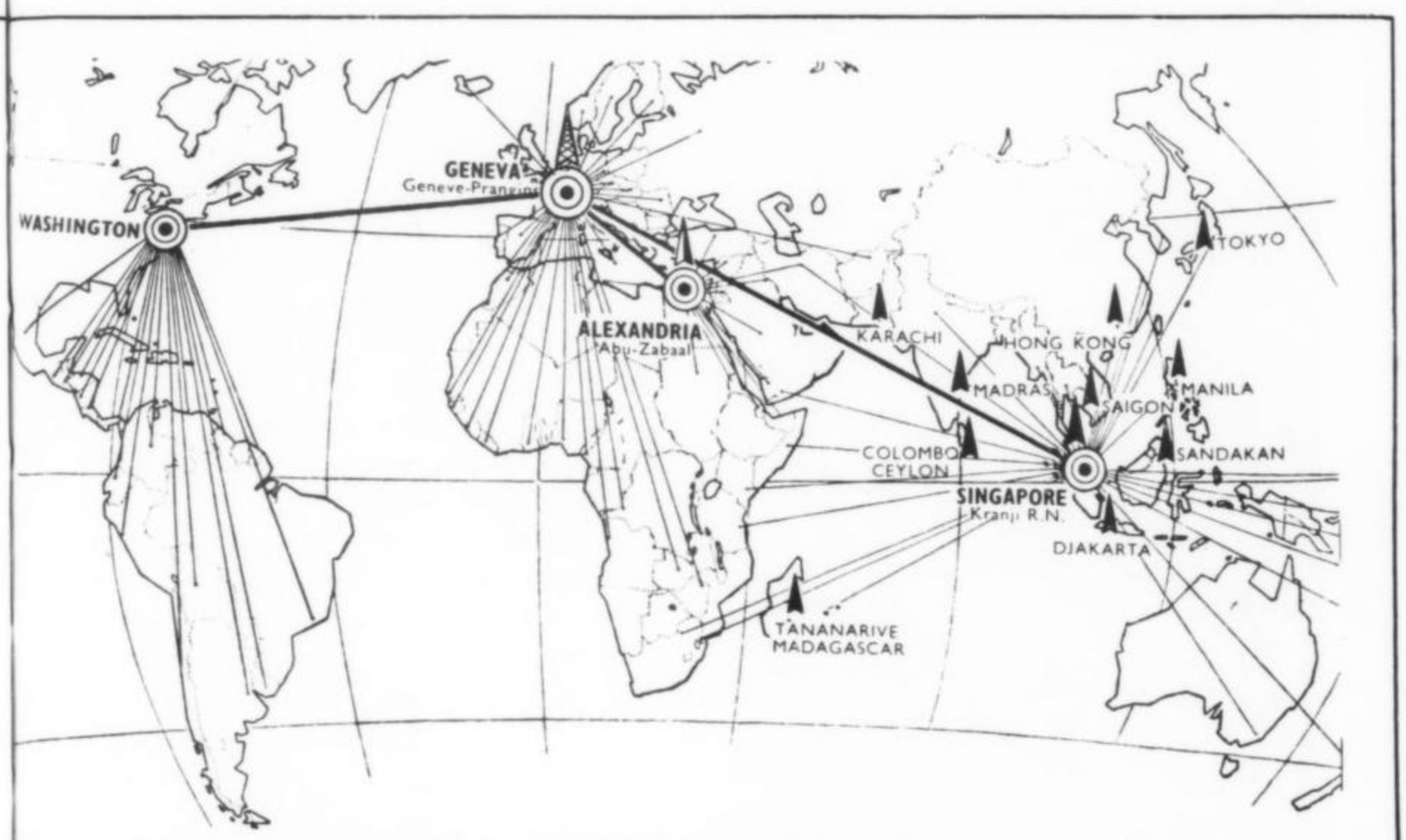
When the risk is less, and formal "surveillance" is not considered necessary, perhaps, for example, if the case had been discovered at the beginning of the voyage and no other cases had occurred, passengers might only be given a yellow warning card, urging them to call in a doctor at once if they fell sick and to show him the card which would alert him to the possibility of smallpox.

Another factor in modifying quarantine practice has been the introduction of air travel whereby a man may arrive from a distant country well within the incubation period of the diseases prevalent in the country of departure.

To examine him on arrival would be fruitless, since the signs and symptoms of disease would not yet have appeared. To isolate him until the incubation period was over would be intolerable and would stultify the whole purpose of air travel. But, according to circumstances and the diseases in question, he can be immunized sufficiently long before his departure to prevent him starting an epidemic in the country of arrival.

Thus "quarantine" measures have become steadily more rational and less restrictive, and the well-immunized traveller has little to fear. The ultimate aim, of course is to abolish the need for any restriction, by stamping out these diseases themselves in the areas in which they are endemic. This is a long-term policy though given the money, effort and co-operation of the countries concerned, it could be done.

To sum up, governments began to co-operate in health matters about 100 years ago, not from idealistic motives but because hard-headed business men and officials decided that agreement must be reached with the doctors on the maximum measures which could be applied everywhere to keep epidemic diseases from spreading from one country to another, and that these measures must be accepted in every country.



Information on epidemic diseases is continuously collected from all parts of the world by the World Health Organization headquarters in Geneva, and re-transmitted to all health authorities. Map shows the radio-telegraphic network that makes this service possible.

'Wens and excrescences'

THAT it took more than 50 years to achieve this was due to lack of definite knowledge on how these diseases were spread, as well as to international political rivalries. Once agreement had been reached, it was necessary to create international bodles to oversee the working of the conventions embodying the agreements, and the creation of the World Health Organization permitted for the first time a single world-wide international authority to become responsible over this whole field.

Advances in medicine and in communications have allowed the original conception of quarantine as a kind of sanitary police and prison system to be modified in the direction of greater freedom combined with greater safety, based on the co-operation of the public—though the powers are still there should they be needed.

The philosophy written into the International Sanitary Regulations now in force is to give the maximum security against the importation of these diseases with the minimum interference with world traffic. The success achieved in the first three years of application of the International Sanitary Regulations augurs well for the future.

To have been associated with this work, as with other accomplishments in the international health field, brings appreciation of the words written by John Donne 300 years ago: "To be no part of any Body is as to be nothing. For the greatest Persons are but great wens and excrescences except they be so incorporated into the body of the world that they contribute something to the sustentation of the whole."

This article originally appeared in an unabridged form in Unilever's magazine "Progress".

The unwanted travellers

THE march of civilization, with ever faster travel by ships and aircraft, has also helped the disease-carrying insects to colonize new territories and launch fresh epidemics. To stamp out the intruders often takes years of tedious struggle.

★

THERE is one kind of aircraft passenger, which does not appear in the passenger lists and often escapes the sanitary control authorities. These are insects which may lodge in the cabin of the aircraft or in the luggage hold or be taken in on the clothes of passengers or even on flowers which may be presented to them. Most often they are mosquitoes, flies, fleas, lice, sometimes ticks, beetles, cockroaches, Colorado beetles, and still others whose presence is always disagreeable but may also be dangerous for man, livestock and agriculture.

★

THE behaviour of insects in aircraft in flight has been closely observed. Altitude, changes in air pressure and temperature during long flights do not permanently affect the insects. They live in aircraft for as long as they can exist without nourishment—that is, of course, if they cannot find what they need in the aircraft itself.

★

CERTAIN insects have been known to lay their eggs on the outside of aircraft on the wings, the fuselage, the rudder and even on the propellers! These eggs were found to be still there at the end of the journey: neither the wind nor the altitude nor yet changes in temperature had affected their capacity for survival. On one single plane thousands of larvae emerged from the eggs and swarmed over the surface of the aircraft. Strict surveillance of aircraft and airports is absolutely essential.

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IT was undoubtedly on board a fast boat that the malaria-carrying mosquito, *Anopheles gambiae*, crossed from West Africa to Brazil in 1930. This mosquito is particularly dangerous since it is essentially "domestic", prefers biting human beings, and breeds easily near human habitations. In 1931, a campaign was organized at Natal (Brazil), which was the point of entry of *Anopheles gambiae*, and as a result the mosquito was cleared from that port. However, it found terrain favourable to its development in the interior of the states of Rio Grande do Norte and of Cesra. The result was a murderous epidemic of malaria lasting up to 1938 when a special control service was organized in that region of north-east Brazil. Thanks to its efficient organization and abundant resources it was able to eliminate these mosquitoes from Brazil in about two years.

★

Anopheles gambiae inhabits the whole of tropical Africa and it periodically invades certain temperate zones and spreads malaria there. In 1942, for example, probably as a result of military movements, these mosquitoes invaded Upper Egypt and the number of cases of malaria in 1942-1943 was estimated at 140,000. Energetic extermination measures undertaken in 1944 led to the complete disappearance of the species by February 1945. Such examples of eradication of a species of mosquito, carried out on a large scale and at great cost, effectively demonstrate what may be the consequences of the accidental introduction of an insect carrier of disease.

★

THE regular deratting of ships, and the rational use of insecticides on board ship and aircraft, or for passengers and their luggage, have proved to be effective in preventing any epidemic of pestilential disease in the past 25 years.

This is the aim of the World Health Organization International Sanitary Regulations which, on the basis of up-to-date epidemiological and other information, lay down the preventive measures which should be taken, while at the same time reducing to the strict minimum any inconvenience or delay caused to international passengers or goods traffic.

ASIA'S FIRST PENICILLIN FACTORY

Penicillin, a vital arm in the battles against disease and epidemics, is still missing or is in short supply on many of the fronts where the world war for health is being waged. Penicillin production, however, is now being increased through aid given by the U.N., the World Health Organization (WHO) and the U.N. Children's Fund (UNICEF). Asia's first penicillin factory, set up with help from these organizations at Pimpri, near Poona, India, has increased its production to 1,000 pounds per month, since it began to operate in March 1955. Thirteen Indians have so far been trained abroad and have now become the key staff at the plant. Technical Assistance funds were used to provide international

personnel to guide the project, supervise, the construction and erection and develop the operating techniques. Above, a locally-trained technician makes a biological test in laboratory of potency of the penicillin produced. WHO and UNICEF also recently joined hands with the Government of Yugoslavia in modernizing and expanding the only penicillin processing plant in this country. Left, girls bottling penicillin in a sealed, sterilized glass cabinet at the Zemun plant near Belgrade, Yugoslavia.

UNATIONS

Letters to the editor...

Sir,

The UNESCO COURIER has been a tremendous benefit to me, increasing my knowledge and understanding of the culture of other people. I would be so pleased if you could put me in touch with the readers in other lands who may like to make an exchange of some of the primitive native art of their own countries for some original aborigine bark paintings from Arnhem Land. With very good wishes.

Oscar Edwards.

Sydney, New South Wales,
Australia.

EDITOR'S NOTE : *In issue N° 11, 1954, the* UNESCO COURIER *published an article on Australian aborigine paintings from Arnhem Land : "An art on bark and stone", together with full colour reproductions.*

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A MYSTERIOUS, SPINNING 'ELECTRIC EGG'

A gleaming metal egg which whirled round at top speed and then stood on end intrigued visitors at a Unesco travelling science exhibition, "Energy And Its Transformations", which opened in Paris on March 1. The mysterious behaviour of the egg is easily explained as an application of electromagnetic energy. Four induction coils are placed in a square pattern beneath a concave sheet of glass, in the centre of which is the aluminium egg. Electrical currents with a difference in phase of ninety degrees are passed through the coils. The egg becomes the centre of induced currents which create a torque (two equal and parallel forces acting in opposite directions). The egg begins to turn until, under the action of centrifugal force, it slowly becomes inclined. When it is turning with sufficient speed, the egg rises on end and continues to spin round and round. The "electric egg" is one of many fascinating exhibits in the travelling exhibition which will shortly leave for a three years' tour of cities in the Far East. Four earlier Unesco science exhibitions have been viewed by nearly 2,000,000 people in 32 countries during the past five years.

Sir,

Couldn't you devote one of your issues to the question of religious tolerance which, as you must be aware, does not exist in many countries, even in those referred to as "civilized"? Also, could not UNESCO launch a campaign for the abolition of that medieval anachronism the death penalty?

Strasbourg-Neuhof, J.-P. Thomas.
France.

Sir,

In your June, (U.S.A.) 1955, issue (European, N° 6, 1955) you published an article by Lucien Bernot and René Blancart, "What a French Village Thinks of the Foreigner". The questionnaire used by the UNESCO research team listed Jews as one of the "peoples" investigated.

As you probably know there is considerable question in the minds of anthropologists regarding this designation of Jews as a "people". Most social scientists, of course, classify Judaism as a religion; Jews however, who are citizens of various countries, are considerd to be French, British or Americans as the case may be. Under the circumstances, the grouping utilized by the research team seems to leave something to be desired. It would probably have been more accurate also had the list included such categories as Catholic and Protestant in addition to Jews. This would have permitted comparison of respondents' attitudes towards different religious groups.

Marc Vosk.

Director, Div. of Scientific Research,
The American Jewish Committee,
New York 16, N. Y.

Sir,

Reading the February 1956 issue of your magazine (U.S., April) I found the article on the earthworm excellent. This is a humble yet surprising creature and I think the article must have interested all your readers. I personally would have liked to see a rather more complete study.

Boulogne, Guy Fort.
Seine, France.

Sir,

With each issue of the UNESCO COURIER I am more impressed with the work of UNESCO and more encouraged in the never-ending struggle for making this world a better one for all mankind. This magazine is required reading for all students in Music Education at Southern Illinois University. Thank you for your wonderful work.

Carbondale, Robert Forman.
Illinois, U.S.A.

Sir,

I am glad to have "met" the UNESCO COURIER. It is the best and most urgently needed paper I ever read. At my school I am going to try to form a study-group among the teachers to discuss the articles.

Bjorkfors, Espinara, Gustav Wikstrom.
Sweden.

From the Unesco Newsroom

OUTCASTS NO LONGER: Growing confidence in new anti-leprosy drugs and the fact that leprosy sufferers are no longer treated as outcasts means that fewer people conceal their disease and more are seeking treatment in World Health Organization (WHO)-assisted campaigns. WHO which has been aiding leprosy control work in 12 countries during the past six years is now to extend this help to six other countries. In 1942 estimates of the number of leprosy victims in the world ranged from between two and seven million. Revised figures place the number today at between ten and twelve million. This does not mean that leprosy has increased, but simply that more cases are known about. It is a myth that leprosy is highly contagious. Risks of contracting it are smaller than those associated with tuberculosis.

■ **SCHOOLS IN THE SNOW** : *Many French city schoolchildren have been gaining health and vigour this winter from "snow classes", first started as an experiment in winter sports centres two years ago. Morning classroom lessons, afternoon ski instruction, evening homework, then games and a long night's rest make up the day's programme. Teachers report a striking improvement in both the work and the morale of the children. Most of the cost of sending classes to the mountains is paid by the Ministry of Education and local authorities.*

CUBAN CRITICS CONCUR : The Unesco film "World without End" has been selected by the Cuban Association of Theatre and Cinema Critics as the best film of 1955 in the category of non-commercial documentaries. The international selection of the best films of the year was made by the Association to commemorate the 60th anniversary of the first public moving picture show and as a tribute to the Lumiere Brothers who organized it in Paris in December 1895. (See the Unesco Courier, No 1, 1955.)

■ **ATOMS FOR ASIA** : *As soon as atomic power stations can be built economically enough to produce cheap power, the tremendous possibilities of atomic energy can be used to improve living standards in under-developed countries. Though this is not likely to happen for another decade or so, long-term planning is already in progress. Recently a committee of the U.N. Economic Commission for Asia and the Far East met in Bangalore, India, to discuss the role that atomic energy may play in Asian countries. It discussed how technically advanced countries at present engaged in atomic research and development can eventually help other nations to train technicians to prospect for radioactive minerals and how information on the latest nuclear techniques can be exchanged.*

RURAL SCIENCE CENTRES: India is to set up a network of rural science centres which will advise people in villages and small communities on the practical application of science in everyday life. Centres will operate as laboratories for applied science where secondary school pupils will receive training and practical experience. The centres are being planned on the basis of successful results obtained at an experimental centre in New Delhi State.

■ **SOIL DOCTORS** : *Since* 1954 *a land rehabilitation team has been working in an erosion-wrecked section of Jamaica to improve living standards in a mountainous area of some* 55,000 *acres where* 60,000 *persons must cope with the problem of wasted land. The team will shortly be joined by Dr. G.J. Kruijer, a Dutch sociologist, who is being sent there by* Unesco *under the programme of assistance to its member states in fields not normally covered by the U.N. Technical Assistance programme.*

HUNGRY FOR MUSEUMS: Public interest in museums is growing in Hungary where during the past two years more than five million people have visited the various collections. Budapest has now twenty museums (twice the pre-war figure) while every provincial town of any importance has its own collection, generally devoted to regional, archaeological, historical and folklore exhibits.

■ **PAKISTAN'S 'SCIENCE HOUSE'** : *The foundation stone of a national science institute which will eventually house a library of some* 250,000 *scientific works was laid recently at Lahore, in West Pakistan. Called the Ismail Aiwan-i-Science (Ismail Science House) after the benefactor of the project, it will provide a meeting place for scientists and will give Pakistan its first comprehensive scientific library, now being planned in consultation with* Unesco.

TRAINING REFUGEE TEACHERS : Unesco experts and Arab instructors are drawing up curricula for two new teacher training centres, one for men and one for women, which have been opened in Jordan by the United Nations Relief and Works Agency (Unrwa). The centres will train teachers in up-to-date methods suited to Unrwa's educational programme for Arab Refugee Schools, over 300 of which have been set up in Jordan, the Lebanon, Syria and the Gaza area. (See the Unesco Courier, No 7, 1955 — "Schools in the Sand".)

■ **PLANNING AT PHNOM-PENH:** *Four countries—Cambodia, Laos, Thailand, and Vietnam—are to join efforts to rid the Indo-Chinese peninsular of its most expensive and debilitating disease—malaria, it was announced at a recent conference in Phnom-Penh, Cambodia, sponsored by the World Health Organization. Delegates proposed to set up an Anti-Malaria Co-ordination Board with* WHO *providing technical advice. No country, said the delegates, could be safe from malaria if its neighbours harboured the disease, since "mosquitoes recognize no territorial or political boundaries".*

HISTORY IN WOOL: The famous Bayeux Tapestry which attracts some 50,000 visitors to Bayeux Museum in northern France each year, will soon be seen by a far wider public. A documentary film in colour has been made of the tapestry, in French and Spanish versions, which will be shown throughout the world. A wool-embroidered canvas 231 feet in length, the tapestry was completed about the year 1092, and shows different stages in the conquest of Britain by William, Duke of Normandy.

■ **T.V. GOES BACKSTAGE:** *Television has found a "behind the scenes" job in the Vienna State Opera House, which re-opened last November. It is helping the conductor of the choir, backstage, to take his cue from the orchestra conductor, in front. As in many opera houses, the Vienna Opera choir is behind the stage and invisible to the audience. A miniature television camera fitted into the prompter's box, facing the orchestra, relays the conductor's movements to a screen installed behind the stage where choirmaster and singers await their cue.*

SPECIAL BINDER FOR THE "UNESCO COURIER"

Special binders in which readers can keep their year's collection of issues of the UNESCO COURIER will shortly be available. Watch for special announcement with full details next month.

AFRICA'S FIRST CYCLOTRON: A cyclotron—an atomic particle accelerator—which recently began operating near Pretoria, in the Union of South Africa, will produce short-life radio-isotopes for use in industry, agriculture and medicine. These isotopes cannot normally be imported from Europe or the United States owing to their short lifespan. The cyclotron—Africa's first—will also be used to train South Africa's nuclear physicists.

■ **WELCOME TO GERMANY:** *A varied programme for youth groups from abroad visiting Germany this summer is offered by the German Association for International Youth Exchange, in Bonn, German Federal Republic. Some well-equipped residential centres are recommended by the Association which also supplies information on study tours and arranges school exchanges and holidays for members of youth groups as paying guests in German families.*

The Subscription Dept of the UNESCO COURIER wishes to remind readers that it can guarantee to service subscriptions without interruption only if renewal remittances are made immediately upon receipt of notification of expiry.

Imp. GEORGES LANG, PARIS-19e. - IMPRIMÉ EN FRANCE

Vacations Abroad
Vacances à l'étranger
Vacaciones en el extranjero

The 1956 edition of this annual *Unesco* handbook, now available, gives details in English, French and Spanish of nearly 950 summer courses, study tours, work camps, youth and student centres, hostels and holiday camps, of interest to persons wishing to combine educational experience with travel abroad during their vacations in 1956. These activities take place in 57 countries in Europe, Asia, Africa and America. There is also a section on vacation scholarships open to participants in summer schools. *Vacations Abroad* can be obtained from the *Unesco* national distributors. Price: $1; 5/-; 250 francs.

An extra-special issue :

BUDDHIST ART

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★

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A WINDOW OPEN ON THE WORLD

The UNESCO Courier

WHO - Pierre Pittet

BIG MENACE IN A TINY SPACE

The tsetse fly shown much enlarged here is actually only half an inch long, its wingspread one inch. The proboscis, the fine tube with which it punctures the skin to suck blood, is the thin line seen between the two "feelers" or palps. The dreaded tsetse fly produces the sleep that ends in death. Slayer of cattle, killer of men, it is one of the great scourges of tropical Africa. In over four and a half million square miles of Africa the bite of the tsetse fly may infect man with a minute organism which produces the fatal sleeping sickness, or may transmit other organisms fatal to cattle. But today it is slowly being driven from its empire —an area half as great again in extent as the continent of Australia. (See page 12)